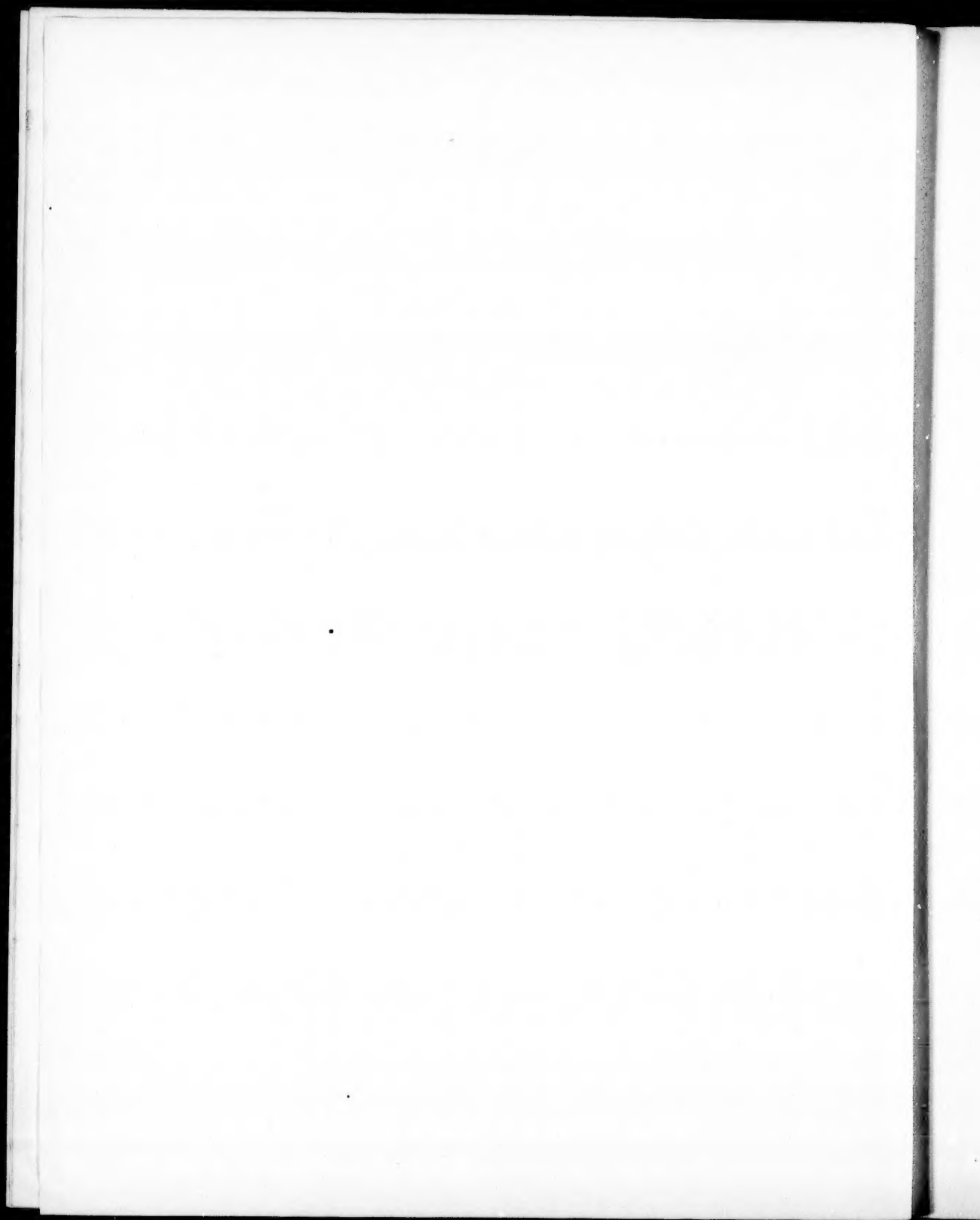




EXPLORATIONS AND SURVEYS FOR A RAILROAD ROUTE FROM THE MISSISSIPPI RIVER TO THE PACIFIC OCEAN.
WAR DEPARTMENT.

REPORT

OF

LIEUT. HENRY L. ABBOT,

CORPS OF TOPOGRAPHICAL ENGINEERS

UPON

EXPLORATIONS FOR A RAILROAD ROUTE,

FROM

THE SACRAMENTO VALLEY TO THE COLUMBIA RIVER,

MADE BY

LIEUT. R. S. WILLIAMSON,

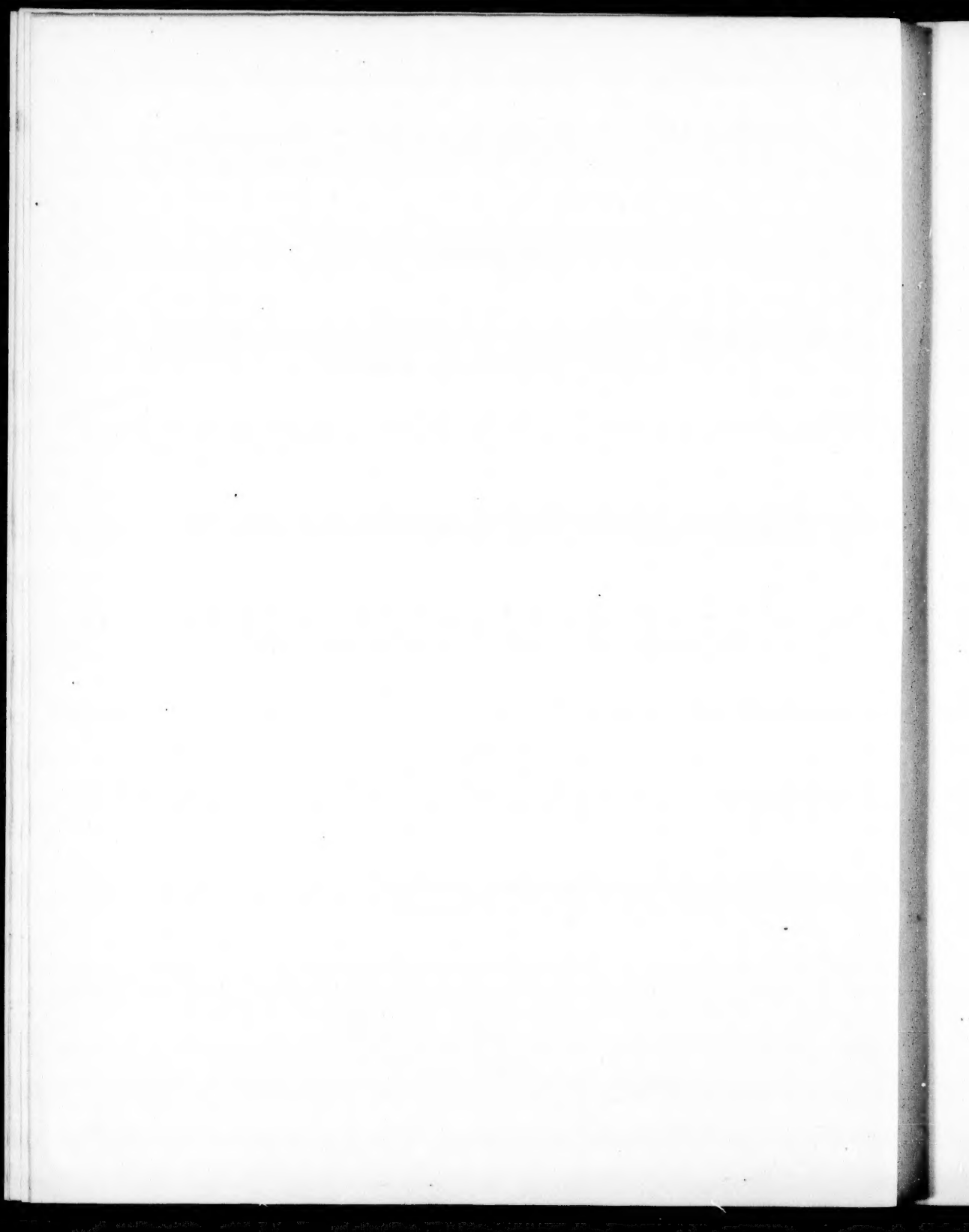
CORPS OF TOPOGRAPHICAL ENGINEERS,

ASSISTED BY

LIEUT. HENRY L. ABBOT,

CORPS OF TOPOGRAPHICAL ENGINEERS.

1855.



LETTER TO THE SECRETARY OF WAR.

WASHINGTON, D. C., *May 6, 1857.*

SIR: In obedience to instructions from the War Department, I have the honor to submit the accompanying report of the exploration and survey in California and Oregon, conducted by Lieutenant R. S. Williamson, United States Topographical Engineers, in 1855. The preparation of the report has devolved upon me, in consequence of the severe and protracted illness of Lieutenant Williamson; and it is due to myself to state that I have performed the duty with extreme reluctance, partly because it was not originally designed for me by the Department, and partly because it properly belongs to the officer by whose forethought and professional ability the expedition has been brought to a successful termination.

Wishing to convey Lieutenant Williamson's ideas, as far as they are known to me, I have been guided by his recorded field notes, and by his opinions expressed to me in conversation, in preparing the portion of the report which relates to regions traversed by him. During a part of the field work I was entrusted with a separate party, with instructions to prepare a written report of the results of my examinations. For any opinion given in this portion of the report he, of course, is not responsible.

At the completion of the survey for a railroad route from the Sacramento valley to the Columbia river, the season was so far advanced and the animals were in so jaded condition, that Lieutenant Williamson considered it impracticable to make any examination of the Sierra Nevada until the ensuing spring. Before that time, orders were received from the War Department, directing him to return at once to Washington to prepare the maps, profiles, and reports of the exploration already made. The second survey contemplated in his original instructions was consequently omitted.

At Lieutenant Williamson's request, I have prepared a full statement of the method used in deducing altitudes from the barometric observations. For unpublished and very valuable information on this subject, I am indebted to Captain A. W. Whipple, United States Topographical Engineers.

I should do injustice to Lieutenant Williamson, if I did not express his high appreciation of the energy and ability with which the officers of the escort, and the civil assistants, labored to advance the objects of the exploration.

Of those who accompanied me when detached from the main command, I feel at liberty to speak in less general terms. Lieutenant Crook, who was the only officer with me, officially and personally contributed, in a high degree, to the success and to the harmony of the expedition. Mr. Fillebrown and Mr. Young, although suffering from severe attacks of intermittent fever, and deprived of the services of a physician, willingly continued with the party, and discharged their accustomed duties with energy and accuracy. The masterly sketches of views upon the route, and the characteristic style of the topography upon the accompanying maps, testify to the professional skill of Mr. Young. Mr. Anderson, who was my only scientific assistant in some of the most difficult and perplexing portions of the survey, aided me in every way in his power. To him, and to Mr. Fillebrown, the government is chiefly indebted for the numerous barometric observa-

tions taken upon the routes explored. Dr. Newberry was only attached to my command for a few days, as he proceeded by water from Fort Dalles to San Francisco, where he remained until the completion of the field work. While waiting in that city he zealously occupied himself in making a large and valuable zoological collection. His reports speak for themselves. The great energy which Mr. Coleman displayed in discharging the laborious duties of chief of train, is worthy of the highest praise. Had it not been for his continued and untiring exertions, many of our animals must have been lost in crossing the Cascade mountains. To the men of the topographical party generally, much commendation is due. Although deprived of the protection of an escort, and of the services of a physician, to both of which they were entitled by the terms of their agreement, they, with hardly an exception, faithfully performed their duties until the end of the survey.

I am, sir, very respectfully, your obedient servant,

HENRY L. ABBOT,
2d Lieut. U. S. Topographical Engineers.

Hon. JOHN B. FLOYD,
Secretary of War.

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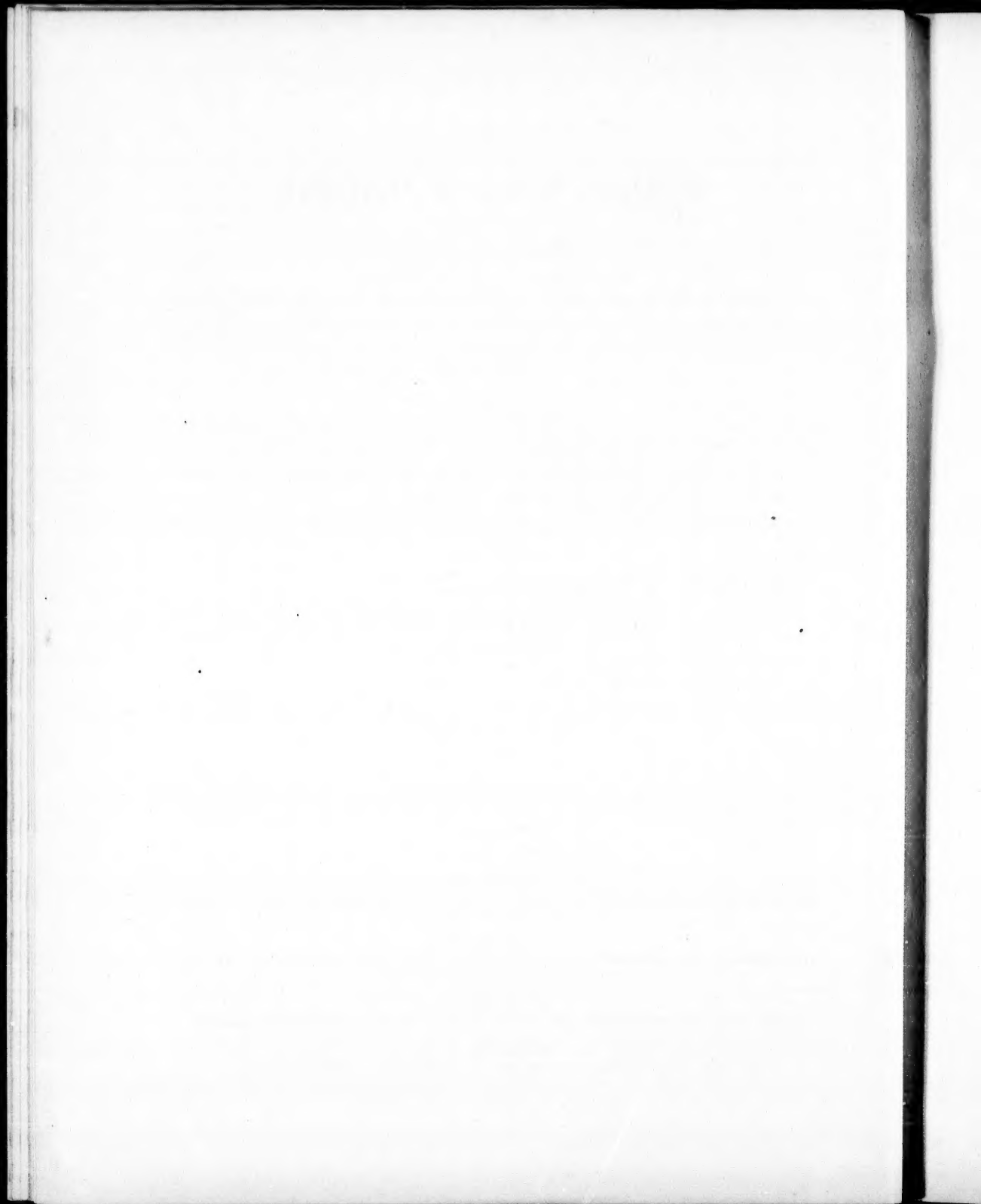
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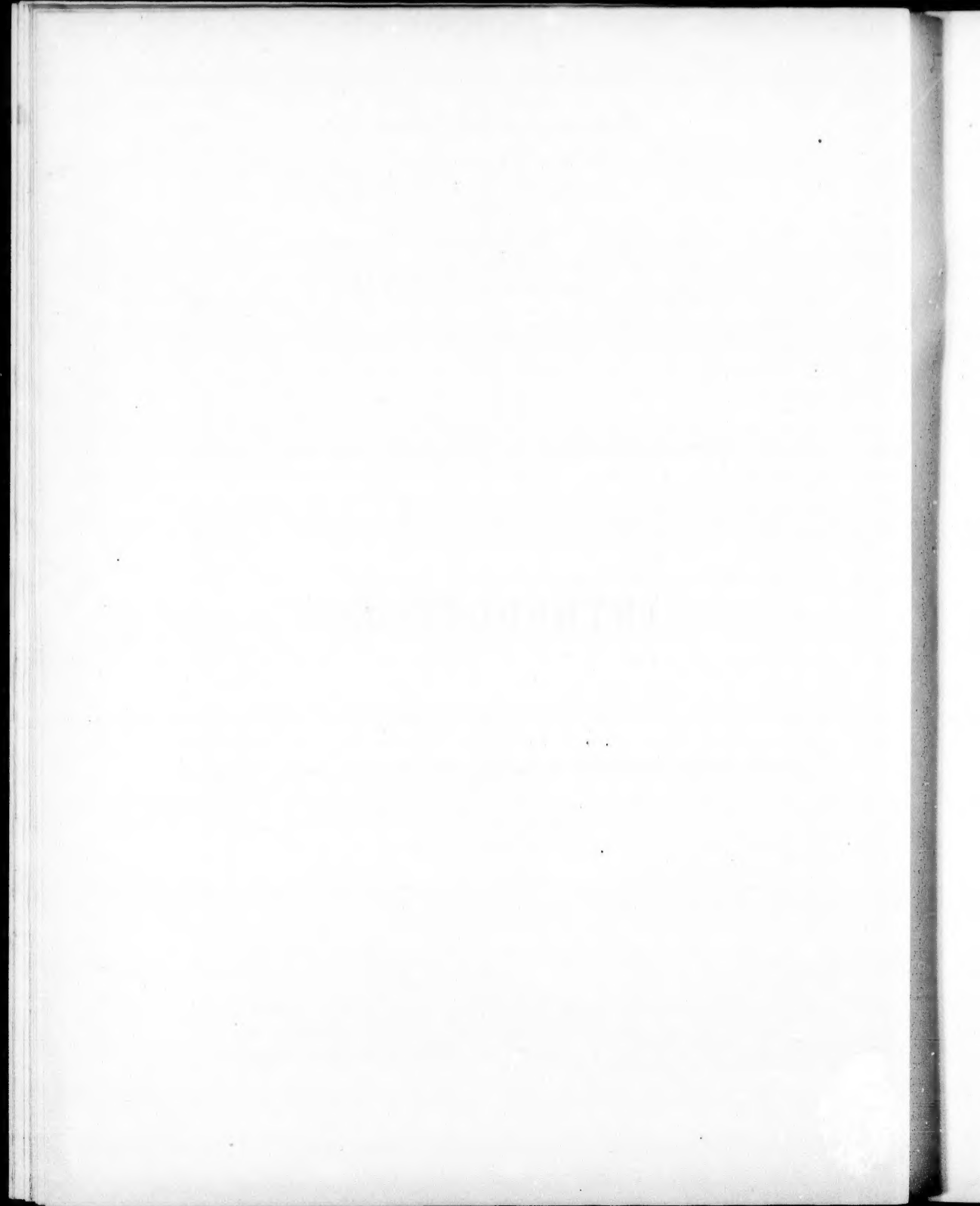
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INTRODUCTION.



INSTRUCTIONS FROM THE WAR DEPARTMENT.

WAR DEPARTMENT, *Washington, May 1, 1855.*

SIR: The following duties are assigned to you, under the appropriations for continuing explorations and surveys to ascertain the most practicable and economical route for a railroad from the Mississippi river to the Pacific ocean, and for military and geographical surveys west of the Mississippi.

1. To make such explorations and surveys as will determine the practicability, or otherwise, of connecting the Sacramento valley, in California, with the Columbia river, Oregon Territory, by a railroad, either by the Willamette valley, or (if this route should prove to be impracticable) by the valley of Des Chutes river, near the foot slopes of the Cascade chain. Along Des Chutes river the character of the country is such as to render it improbable that a practicable route can be found.

2. To make the necessary examinations and surveys to determine if a route practicable for a railroad exists crossing the Sierra Nevada, at or near the source of Carson river. This may furnish the most direct railroad route from San Francisco to the Great Salt Lake. The duty first assigned you having been completed, you will ascertain from the commanding officer, Lieut. Col. Steptoe, and others of the troops that may have crossed the Great Basin from Great Salt Lake and the Sierra Nevada, by the route near the sources of Carson river, all the details necessary to a knowledge of the character of the route traversed by them; and should the information which you may have gathered lead to the opinion that the route is practicable for a railroad, or that such route may be found in that region, you will proceed to make the examinations and surveys necessary to ascertain if such be the case. It will not, probably, be necessary to extend this examination beyond the eastern foot of the Sierra Nevada.

If you should not require the services of all your party, for this latter duty, you will direct such of your assistants as will not be wanted for the field, to proceed to Washington, with Lieut. Abbot, and under his direction prepare the maps and reports; or you may direct Lieut. Abbot, aided by the geologist and civil engineer, or such assistants as may be necessary, to make the examination, proceeding yourself to Washington with the other assistants.

The geological information is considered especially valuable in determining the character of the country, the nature of the difficulties to be encountered, and the quality and extent of the building materials to be found.

Your attention will be directed to the botany and natural history of the country, and to such other objects as tend to illustrate its present and future conditions.

To execute these orders, you are authorized to employ the following assistants, viz: a geologist, a civil engineer, a computer, a draughtsman, and a physician, who will, at the same time, perform the duties of naturalist or geologist, if an assistant surgeon cannot be assigned to duty with the escort, at rates not exceeding those proposed by you in your estimate.

They will receive, besides their stipulated compensation, the actual cost of transportation to and from the field, if the journeys or voyages have been actually performed, and they will have the privilege, while in the field, of purchasing from the subsistence department such provisions as may be necessary for their subsistence.

You are also authorized to employ such hands, packers, &c., as may be necessary; to purchase such of the instruments, named in your estimate, as cannot be obtained from the Topographical Bureau, and such smaller instruments, maps, books, camp and garrison equipage, animals, quartermaster's stores, provisions, &c., as may be necessary to the successful accomplishment of the objects of the expedition.

The commanding officer of the Pacific Department will be directed to furnish you with an escort of (100) one hundred men, with not less than three regimental officers and an assistant surgeon, if one can be spared from other duty, one of the former to act as commissary and quartermaster to the party; and to instruct the commanding officer of the escort to afford you such aid and assistance as will most tend to facilitate your operations. A large escort will be required to protect the exploring party in Oregon, but in the subsequent part of your surveys it may be diminished.

Lieutenant Henry L. Abbot, Topographical Engineers, will be ordered to report to you for duty.

The colonel of the Corps of Topographical Engineers will direct that such of the instruments named in your requisition, as are in depot at the Topographical Bureau, or at Benicia, California, and not required for other service, be supplied to you.

The quartermaster's department will furnish you with horses, mules, equipments, and such other public property as may be needed for the use of the expedition, if they can be spared; which will be returned to that department upon the completion of the field duties, payment being made for such animals as may have been lost, or as may be found unfit for use, and other public property lost or seriously damaged.

The commissary department will furnish you with such provisions and stores, if they can be spared, as you may need for the use of the expedition, to be paid for out of the appropriations for the survey, at cost prices at the place of delivery.

The ordnance department will furnish arms, accoutrements, and a mountain artillery forge, payment to be made for such arms, &c., as are lost or seriously injured.

You are authorized to purchase, for the purpose of trafficking with the Indians and compensating them for services, such articles of Indian goods as are most desirable for such purposes, provided the expenditures for these articles do not exceed (\$300) three hundred dollars.

The sum of (\$42,000) forty-two thousand dollars is set apart from the appropriations for the expenses of the survey entrusted to you.

With your assistants you will proceed without unnecessary delay to San Francisco, and there organize your party, unless upon your arrival you should ascertain that it would be preferable to organize it in Oregon; in which case you will proceed to Vancouver, and organize your party at the most suitable point to commence the survey from the Willamette valley.

The duties assigned to you being completed, you will discharge your party, dispose of your outfit to the best advantage, and proceed with your principal assistants to this place, and make out your report.

Should the views of the department be modified, you will receive further instructions.

You will make the usual monthly reports of the work done; and, besides, advise the department from time to time of the progress made in, and the results of the explorations.

Very respectfully, your obedient servant,

JEFFERSON DAVIS.

Secretary of War.

Lieut. R. S. WILLIAMSON, *Corps Topographical Engineers, Washington.*

OFFICE PACIFIC RAILROAD SURVEYS,

Washington, May 1, 1855.

SIR: By direction of the Secretary of War, you will report to Lieut. R. S. Williamson, Topographical Engineers, for duty on the explorations and surveys in California and Oregon, with which he is charged.

It is understood that you are second in rank of the party, and that, if sickness or any accident should disable Lieut. Williamson, so as to oblige him to relinquish the command, you will succeed to the charge and command of the party.

Very respectfully, your obedient servant,

A. A. HUMPHREYS,

Captain Corps Top. Engineers,

In charge of office for Pacific Railroad Surveys.

Lieut. HENRY L. ABBOT,

Corps Topographical Engineers.

SYSTEM ADOPTED IN PREPARING THE REPORT.

In preparing the report of the explorations and surveys, made in accordance with the above orders, I have adopted the following system: Part I contains the general report, divided into seven chapters; of which the first contains a general description of the different regions traversed during the survey. This synopsis has been prepared partly to enable those wishing merely to obtain a general idea of the country, to dispense with reading a mass of details, and partly to render the railroad report more intelligible. The second chapter is devoted entirely to a discussion of the facilities offered for the construction of a railroad near the lines of survey. The third, fourth, and fifth chapters contain a narrative and itinerary of the expedition. An attempt has been made to give, in this portion of the report, a detailed description of the nature of the country examined; of the supply of wood, water, and grass near the trails; of the character of the Indian tribes; and of various other matters, interesting to those who wish to thoroughly understand the character of the regions explored. The sixth chapter contains a statement of the method used in computing altitudes from observations taken with the barometer. The seventh chapter contains an account of a former exploration of Lieut. Williamson, near a portion of our line of survey.

Parts II, III, and IV, contain geological, botanical, and zoological reports upon the regions explored.

The various appendices exhibit, in a tabular form, the astronomical and barometric observations, with the results deduced from them by computation.

MAPS ACCOMPANYING THE REPORT.

Two maps, constructed upon the polyconic projection, have been made to accompany this report. The first illustrates that portion of the survey which lay in California, and the second that in Oregon. The scale of each is one inch to twelve miles, or 1:760320.

The data, upon which these maps have been constructed, will be briefly stated. The distances

travelled were measured by an odometer, until the wheels were necessarily abandoned among the Cascade mountains; and then carefully estimated from the time and supposed rate of travel. The courses were determined by prismatic compasses. The latitudes of a large majority of the camps were fixed with considerable accuracy by astronomical observations. Several camps before camp 17 were connected with San Francisco by chronometric differences, and the longitude thus approximately determined. An unfortunate accident, in Canoe Creek valley, however, rendered the chronometers worthless for this purpose during the remainder of the survey, and compelled us to depend upon our courses and distances, checked by the latitudes of the camps, and by a system of triangulation among the prominent mountain peaks near the trail. The assumed longitudes of a few important points upon the route seem to require particular explanation.

As Fort Reading was the point from which we started to leave the settlements, great care has been taken to determine its longitude as correctly as possible. Col. J. C. Frémont, on his map of California and Oregon, places the point of Cow Creek, upon which the fort is now situated, in Long. $122^{\circ} 6' 50''$ west from Greenwich. On the Land Office map of 1855, it is placed in Long. $122^{\circ} 11' 9''$. On the map of Lieut. E. G. Beckwith, 3d artillery, illustrating his exploration for a Pacific railroad route near the 41st parallel of north latitude, it is placed in Long. $122^{\circ} 5' 8''$. The four chronometers used on our survey apparently preserved their rates unchanged during our march up the Sacramento valley, as they all agreed very well with each other. The longitude of the fort, determined by their mean corrected difference from local time, was $122^{\circ} 10' 50''$. As this differs only three-tenths of a mile from that given by the Land Office map, it has been adopted as correct. It places the fort 3.5 miles west of Col. Frémont's location, and 5 miles west of that of Lieut. Beckwith.

The following method has been adopted to fix the longitude near the northern terminus of the survey. The longitude of Salem has been determined with considerable care, under the direction of the surveyor general of the Territory, both by astronomical observations and by measuring a line to the coast, and thus comparing the result with the work of the United States Coast Survey. It is $122^{\circ} 53' 43''$ west from Greenwich, as I was informed, when at Salem, by Mr. Hervey Gordon, deputy surveyor. He also told me that Mount Hood and Mount Jefferson had been carefully located by bearings taken from well determined points with the solar compass. I therefore made a preliminary plot of the northern portion of our survey, based upon the Land Office positions of these peaks as fixed points. As over fifty bearings had been taken to each mountain, many of which were from points where the latitude was astronomically determined, I was enabled to slightly correct the relative position of the two peaks. The map was next replotted with respect to these new positions. The result was highly satisfactory, as the compass work fitted admirably, and the longitudes of two points in Des Chutes valley, determined by Col. Frémont in 1843, by observing the occultations of Jupiter's satellites, were almost precisely the same as those of the corresponding points on the plot. It is thought that this coincidence renders it very improbable that any important error in longitude has been made.

The latitude of Fort Dalles was astronomically determined, and numerous bearings upon Mount Hood and the neighboring peaks enabled me to fix its longitude very closely. It was $120^{\circ} 58' 30''$. This location is about three miles west of that found by Col. Frémont, by observing an emersion of Jupiter's second satellite, on November 5, 1843. He afterwards observed the emersion of Jupiter's third satellite, on November 20, 1843, at the same spot, and published the data obtained, without, however, giving the deduced longitude. I find, by computation,

that this is about $121^{\circ} 22' 19''$, which differs more than twenty miles from that deduced from the first observation. I have, therefore, adhered to the longitude given by my field work, which is intermediate between the two, but much nearer that to which Col. Frémont has given the preference.

The longitude of Fort Vancouver has been laid down as given on the latest Land Office map of Oregon Territory, because detailed surveys have been made between the fort and Salem, the position of which, as already explained, has been determined with approximate accuracy. This location of Fort Vancouver is about seven miles east of that of Capt. Wilkes, whose longitude has been adopted by Col. Frémont on his map of Oregon and California, and by Captain McClellan.

Considerable difficulty has been found in locating the Cascades of the Columbia with respect to longitude. Gov. Stevens adopted the position given by Capt. Wilkes, which is 21 miles further towards the west than that of Col. Frémont, who observed an occultation of Jupiter's first satellite, on November 11, 1843, at a point estimated at 15 miles below the Cascades. There is now a line of steamboats plying from Vancouver to the Cascades, and thence to Fort Dalles. Capt. W. B. Wells, the chief proprietor of the line, and all other persons whom I questioned about the matter, declared that the Cascades were about equally distant from Vancouver and the Dalles, by the course of the river. Col. Frémont has so indicated it upon his map; but Capt. Wilkes makes the distance from the Cascades to the Dalles nearly double that from the Cascades to Vancouver. Considering the great discrepancies between these two authorities, and believing that the many hundred trips of the steamboats must have enabled the owner to estimate the comparative distances with tolerable accuracy, I have placed, on the accompanying map, the Cascades midway between Vancouver and Fort Dalles by the course of the river. This location is 10 miles west of that of Col. Frémont and 11 miles east of that of Capt. Wilkes.

I have indicated on the map, positions for Mount Adams and Mount St. Helen's—the former given by eight and the latter by six good bearings from well determined points in the Des Chutes and Willamette valleys, and among the Cascade mountains. Each of these positions differs about 12 miles from that given by Gov. Stevens.

It has been considered desirable to make the maps as complete as possible, by indicating the topography of the country remote from our trail, whenever reliable information as to its character could be obtained. The Pacific coast has, therefore, been laid down as given on the latest United States Coast Survey maps. The most recent Land Office maps of Oregon and California have been adopted as authority for the settled portion of the country, except in the vicinity of our trails, where the topography is, of course, given from our own field notes, checked by astronomical observations.

The map of Lieut. E. G. Beckwith, 3d artillery, illustrating his explorations for a railroad route near the 41st parallel of north latitude, has been followed for the region bordering Pit river, below the mouth of Canoe creek.

The topography south of Suisun Bay has been taken from the map of a survey in California, made, in connection with examinations for railroad routes to the Pacific ocean, by Lieut. R. S. Williamson, Topographical Engineers, in 1853.

Summer lake, the northern and western shores of Upper Klamath lake, the chief tributary of Klamath marsh, and the Columbia river, east of the Dalles, have been laid down as given by Colonel J. C. Frémont on his map of Oregon and Upper California.

From Myrtle creek, in Umpqua valley, to Jacksonville, in Rogue River valley, our field work has been checked by a sketch of the military road, located in 1853 by Brevet Major B. Alvord, 4th infantry. This sketch, which I think was never published, was kindly furnished by Major Alvord.

The trail of Brevet Major H. W. Wessels, 2d infantry, on his expedition of 1852, from Sonoma to Humboldt Bay, and thence up Klamath river to the head of Scott's river, has been laid down from a rough copy of a sketch by George Gibbs, Esq., who accompanied the command as topographer.

The topography near Rogue river, for about twenty-five miles above the mouth, has been taken from a sketch made by Lieut. J. G. Chandler, 3d artillery, to show the routes followed by the command of Brevet Lieut. Col. R. C. Buchanan, 4th infantry, during his campaign against the Indians in 1856. I am indebted to Colonel Buchanan for this sketch, which is now published for the first time.

Lieut. Williamson formerly spent several years in California, attached to the staff of the commanding general. During this time he made many reconnaissances, the results of which were never published. Several of the trails have been laid down on our map from his original field notes. The latitudes of many points were fixed by astronomical observations, and the accuracy of the topography may be relied upon. They form a valuable addition to the map. His route from Yreka to Lower Klamath lake was surveyed in 1852, and that from Yreka, east of Shasta Butte, to the Sacramento valley, in 1851. The trail from Port Orford to Coquille and Rogue rivers, and thence to the settled portion of Rogue River valley, was examined in 1851 and 1852. A small portion of this trail was explored by Lieut. George Stoneman, 1st dragoons. In 1849, Lieut. Williamson accompanied Captain W. H. Warner, Topographical Engineers, on the disastrous expedition on which he was killed by the Indians, near Goose lake. Lieut. Williamson prepared a map of the regions traversed, and the upper portion of Pit river, with the vicinity, has been reduced from the original sketch upon our map.

PROFILES ACCOMPANYING THE REPORT.

Two sheets of profiles have been constructed to illustrate this report. They contain profiles of the most important portions of the routes travelled over by the surveying parties, and also of the most favorable railroad lines found in the vicinity of the trails. The horizontal scale of each profile is the same as that of the maps, being twelve miles to the inch, or 1:760320; the vertical scale is 1:15206.4. They are, therefore, distorted fifty times.

The altitudes of the different stations were all determined by barometric observations. The method by which they have been computed is fully explained in the sixth chapter of this report, and the original data are given in Appendix D.

It only remains to notice discrepancies between the results of this survey and those of former surveys with which it connects. Gov. Stevens gives 57.6 feet for the altitude of Columbia barracks above the level of the sea. That the fort should not be higher than this above the Columbia appeared incredible to me when there; and as it is situated nearly 100 miles above the mouth of the river, there can be, I think, no doubt that this altitude is too low. The height of Lieut. Williamson's camp, situated upon the river bluff opposite the barracks, and sixty feet above the water surface, was shown, by numerous observations, to be 105 feet. I have been unable to find, in any part of Gov. Stevens' report, the height of Fort Dalles. The altitude of 350 feet, however, is given in the Army Meteorological Register as that

determined upon his survey. The altitude of the fort, resulting from our observations, is 476 feet. No correction for abnormal error appears to have been applied to Gov. Stevens' observations; and this omission would very naturally explain larger discrepancies.

Our altitude of Fort Reading differs 157 feet from that of Lieut. Beckwith; and as he had only six observations there, while we had a very large number, I think there can be no doubt that ours is the more reliable result. There are a few other discrepancies in altitudes deduced from his observations and ours, but none that might not be easily occasioned by abnormal oscillation, for which he was unable to obtain any correction in this vicinity. The general agreement between the results of the two surveys, is highly satisfactory.



PART I.

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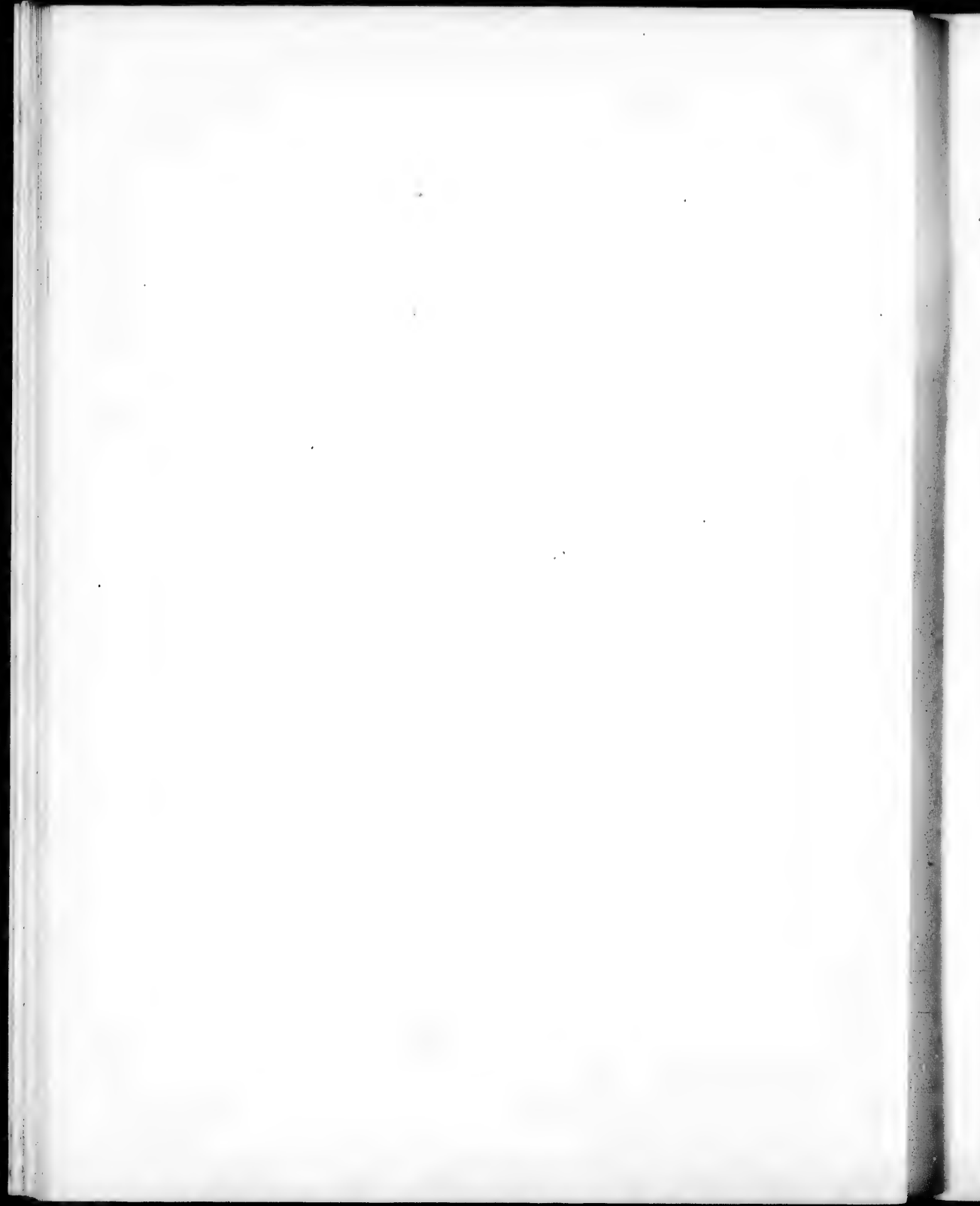


EXPLORATIONS AND SURVEYS FOR A RAILROAD ROUTE FROM THE MISSISSIPPI RIVER TO THE PACIFIC OCEAN.
WAR DEPARTMENT.

ROUTES IN CALIFORNIA AND OREGON EXPLORED BY LIEUT. R. S. WILLIAMSON, CORPS OF TOPOGRAPHICAL
ENGINEERS, AND LIEUT. H. L. ABBOT, CORPS OF TOPOGRAPHICAL ENGINEERS, IN 1855.

GENERAL REPORT.

WASHINGTON, D. C.:
1857.



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CHAPTER I.

GENERAL DESCRIPTION OF THE REGIONS EXAMINED.

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GENERAL TOPOGRAPHY.

THERE is a great similarity in the general topographical features of the whole Pacific slope. The Sierra Nevada in California, and the Cascade Range in Oregon and Washington Territories, form a continuous wall of mountains nearly parallel to the coast, and from one to two hundred miles distant from it. Where examined by our party, the main crest of this range is rarely elevated less than 6,000 feet above the level of the sea; and many of its peaks tower into the region of eternal snow, the lower limit of which is about 8,000 feet above the same level. This long chain of mountains forms a great natural boundary. To the eastward lies a plateau of which the average altitude is about 4,500 feet above the sea. The winds from the ocean deposit most of their moisture upon the western slope of the mountains, and reach the plateau dry. This, together with the volcanic character of the country, renders nearly the whole region an arid waste, unfit to support a civilized population.

West of the Sierra Nevada and Cascade Ranges, the character of the country is widely different. The Coast Range, another and parallel chain of mountains, but of a lesser altitude and of a more broken nature, borders the sea-shore. Between the two lie several large fertile valleys, elevated but slightly above the sea, and containing nearly all the arable land of the far west; of these valleys, the San Joaquin and Tulare, the Sacramento, the Willamette, the Umpqua, the Rogue river, and the Cowlitz are the chief; but the Gulf of California itself may be considered one of the great series, probably produced by a common cause, and differing from the rest only in being submerged.

In northern California and southern Oregon, the two great parallel chains of mountains approach each other; and several ranges, the chief of which are called the Siskiyou, the Umpqua, and the Calapooya mountains, connect them, thus separating the Sacramento and Willamette valleys by a line of transverse ridges. These ridges present the only serious obstacle to the construction of a railroad from the Sacramento valley to the Columbia river. Two routes between these termini were examined by our party. The first crossed the western chain of the Sierra Nevada at the head of the Sacramento valley, and, after passing over the comparatively level plateau of the interior until the transverse ridges had been turned, re-crossed the mountains near the source of the Willamette river, and followed the valley of that stream to the Columbia. The second lay over the transverse ridges. A general description of the region traversed by each of the routes will occupy the remainder of the chapter.

SACRAMENTO VALLEY.

No complete description of this valley will be attempted, as its general character is well known, and as Lieutenant Williamson, in his Railroad Report, has fully discussed its topographical features. A few remarks, however, relating to its climate and productions, may not be out of place.

Sheltered by the Coast Range of mountains from the moist and cool sea breezes, which render the summer climate of the sea-shore of northern California so delightful, much of the Sacramento valley is parched with excessive heat in the dry season. From the Army Meteorological Register, it appears that, at Benicia, where the influence of the sea breeze is felt, the mean summer temperature, for the years 1852, '53, '54, was 66°.3 Fah., while at Fort Reading, which is about two degrees of latitude further north, it was 79°.6 Fah., for the same years. Even at San Diego, situated seven degrees of latitude south of Fort Reading, the mean summer temperature was only 70°.9 Fah., for the above mentioned years.

The effect of this excessively high summer temperature is greatly increased by the want of rain. Very little falls during the months of June, July, August, September, and October. The mean fall, during these five months, for the years 1852, '53, '54, was 1.1 inches at Benicia, and 1.4 inches at Fort Reading. This tends to show that less than three-tenths of an inch of rain per month, for the five consecutive hottest months of the year, is to be expected in this valley. The result can be easily anticipated. Vegetation, except on the banks of the streams, is in a great measure destroyed, and the foliage of the trees furnishes almost the only green upon which the eye of the traveller can rest, when wearied with the glare of the sun, reflected back from the whitened plains.

During the rainy months, which are December, January, February, March, and April, the average fall is between 3 and 4 inches per month. The whole region is then clothed with luxuriant vegetation; but the excess of rain often causes the streams to overflow their banks, and spread far and wide over the low lands. Much of this water remains stagnant, until evaporated by the heat of the sun, which is undoubtedly one of the causes that render intermittent fever so great a scourge of the valley.

Notwithstanding this unfavorable climate, the richness and fertility of the soil well repay the farmer for his labor; and fine crops of barley, wheat, oats, potatoes, onions, &c., can be easily raised. A luxuriant growth of wild oats covers a large portion of the valley, and gives it an appearance of high cultivation. Grapes, which are a natural product, are also one of the very important staples of the region. The forest trees, which, in the valley, are confined to the banks of the streams, are chiefly oaks, sycamores, and cotton-woods. The foot hills of the Sierra Nevada are densely timbered with various species of oaks, pines, and firs.

PIT RIVER AND ITS TRIBUTARIES.

In 1849, Lieutenant Williamson accompanied Captain W. H. Warner, United States Topographical Engineers, on his ill-fated expedition to the sources of Pit river. As this was the only survey of this region which has ever been made, and as its results were never fully published, Lieutenant Williamson proposed to give a synopsis of them in this report. I have, therefore, compiled from his original field notes the following very brief description of the upper portion of Pit river.

A short distance above camp 23, where, in 1855, the party left Pit river, the stream passes

through a broad cañon. The trail, which is a little rocky, follows its course, crossing it about a dozen times. In about 20 miles, the cañon widens out into a valley, varying from 3 to 12 miles in width, which extends to the vicinity of Goose lake. In some places, travelling is rendered laborious by cracks in the soil, which is very light and dusty, but the road is generally good. The region is not fertile, and grass is mostly confined to the banks of the river.

The party discovered a boiling spring about 6 miles above the upper end of the wide cañon, and at some little distance from the river, on its western bank. The basin was about twelve feet wide, and in the middle a jet three feet in diameter boiled up six inches above the general level. No gas escaped, but a slight smell of sulphur was perceptible. A column of vapor, thirty feet in height, ascended from the spring. Its waters were impregnated with salts, but no deposit was observed.

Near Goose lake, Pit river rises from springs in the hills, and does not issue from the lake, as has sometimes been supposed. Much obsidian is found near its sources.

While exploring the mountains in this vicinity, Captain Warner and others of the party were massacred by the Indians, and the survey terminated abruptly in consequence.

The portion of Pit river lying between Camp 23 and the mouth of Canoe creek, was examined on the recent survey. The whole region is volcanic in its character, and descends by successive plateaus towards the western chain of the Sierra Nevada. Each of the two great cañons is situated near the edge of one of these plateaus, and the descent of the stream is, consequently, very much greater in them than elsewhere in its course. From the summit of Stoneman's ridge, this peculiar terraced formation of the country can be very distinctly perceived. The descent of the tributaries, both from the north and the south, is very rapid.

Much of the region south of Pit river, lying at the eastern base of the western chain of the Sierra Nevada, consists of a rocky pedregal of scoriaceous trap, and Lieut. Williamson, who, in 1851, explored the country immediately south-east of Shasta Butte, found the same formation there. It is no uncommon thing in this region, for large streams to sink among fissures in the rocks, and for others to burst from the faces of precipitous ledges. Infusorial marls are common near Pit river.

Although there are a few fertile spots near the banks of the streams, the valley is generally barren, parched with drought during the summer, and unfit to support a civilized population.

Below the mouth of Canoe creek, Pit river forces its way through the western chain of the Sierra Nevada. Lieut. E. G. Beckwith, 3d artillery, surveyed this portion of its course in 1854, and he reports that the stream flows with a winding course among heavily timbered mountains, which rise abruptly to heights varying from 1,500 to 2,000 feet above the water surface.

PLATEAU BETWEEN PIT RIVER AND THE DES CHUTES VALLEY.

After leaving Pit river and before reaching the Des Chutes valley, our course lay over a plateau bordering the eastern base of the Cascade Range. There are occasional low mountainous ridges upon it, but the general surface, for about 150 miles, retains an elevation above the sea varying but little from 4,500 feet.

Most of the region is sterile, although occasional fertile spots are found. Pumice-stone, trap rock, and other volcanic products, strew the ground; and pine forests or sage plains cover the whole face of the country. The banks of the streams, however, are generally bordered with grass of good quality, and we experienced no difficulty in obtaining a sufficient supply for our large train of animals.

The system of drainage on this plateau is peculiar. There are numerous lakes, some of which have no known outlets, although they receive affluents. Wright and Rhett lakes were visited by our party. The former is surrounded by low hills, and, as far as our observation went, receives no tributary, although its waters are fresh. There may be, and doubtless are, springs among the hills, from which it draws its supply. In the rainy season it discharges its surplus waters by Lost river into Rhett lake, which has no known outlet. The level of this lake is 470 feet below that of Wright lake, although the distance between them, in a right line, is only about 6.5 miles.

The chain of Klamath waters is an interesting feature of this region. The highest point upon it visited by our party was near the northern end of Klamath marsh, but Colonel Frémont, in his expedition of 1843-'44, crossed the principal tributary of this marsh. He describes it as a stream thirty feet wide, and from two to four feet deep. It undoubtedly rises, as indicated upon his map, among the mountains east of Upper Klamath lake, and after flowing towards the north for a considerable distance, bends towards the south, and spreads out into Klamath marsh. When it emerges again, it is a large, deep stream, with a sluggish current. After passing through a cañon, four miles in length, the highest points of the sides of which are about 1,000 feet above the water surface, it again spreads out into a fine sheet of water, called Upper Klamath lake. This lake receives several smaller tributaries. The river leaves it near its southern point, and soon winds through a marsh, which forms the northern portion of Lower Klamath lake. Lieut. Williamson, with a detached party, examined this portion of its course, and his opinion was, that in seasons of high water the marsh is overflowed and the river can properly be said to flow through the lake. In the summer, however, its bed is very distinct, and it does not join the sheet of water forming the lake. After crossing the marsh it soon enters the cañon, by which it traverses the Cascade Range. Its subsequent course will be described, in the latter part of this chapter, under the head of "Klamath river and its tributaries." The portion of the plateau through which this chain of waters extends, is occasionally fertile and valuable for agricultural purposes, but most of it is utterly worthless.

DES CHUTES VALLEY.

East of Diamond Peak, the general altitude of the great plateau bordering the Cascade Range begins to diminish. There are many isolated hills and low ridges upon it, but in its general character it now becomes an inclined plain, sloping towards the Columbia river. It is drained by the Des Chutes river, which, flowing in a northerly direction near the foot hills, and receiving many tributaries from the mountains, at length discharges itself into the Columbia.

The Des Chutes river, near its source, flows through a narrow prairie, bordered by a forest of pine, fir and cedar, which occasionally closes in upon its banks. The soil is of a light pumice-stone character. This formation is changed to basalt in about latitude 44° . North of this point, as far as its course is known, the river flows through a deep cañon, broken by numerous rapids which have given it the name of Des Chutes. Its average descent in this cañon is about twenty-five feet per mile. We did not find its tributaries sunk in cañons until we reached about latitude $44^{\circ} 35'$, where we emerged from the foot-hills, and came upon the great basaltic plain, through which the river had been flowing for many miles. This plain is formed by successive layers of trap, of which I once counted as many as seven, interstratified with tufas and conglomerates. Although this stone is exceedingly hard under the hammer, it disintegrates rapidly when exposed to the weather. Not only have all the streams flowing through the plain

worn down their beds to depths varying from five hundred to a thousand feet, but even the torrents of the rainy season have deeply furrowed its surface, and almost destroyed all traces of a level character in that portion lying between the mountains and the river. The plain is thinly dotted with clumps of bunch grass, sage bushes, and a very few stunted pines and cedars, but they are all more abundantly found in the cañons of the creeks.

This steppe is bounded on the north by a spur from the Cascade Range, called, by the white trappers, the Mutton mountains. After crossing the valley, in about latitude 46° , the ridge soon bends towards the south, and gradually disappears. It is in some places thickly wooded with pines and firs, and in others destitute of trees. The prevailing rock is a hard compact slate. North of this spur the sage bushes disappear, and a few post oaks begin to be seen.

At the northern base of the Mutton mountains there is a smaller plain, called Tysch prairie, elevated about 2,200 feet above the sea, and resembling the other in all important characteristics, except that it is much less furrowed by dry ravines. This prairie is bounded on the north by a low range of trap mountains, entirely bare of trees, and separated from it by Tysch creek, a fine little stream sunk in a deep cañon. In this part of Des Chutes valley there are many curious round mounds, from twenty to forty feet in diameter, and from two to six feet in height. They are still more numerous in the vicinity of Fort Dalles, and there has been much speculation concerning their origin. Some persons suppose that they were formed by colonies of ground squirrels in excavating their subterranean dwellings. If so, the race is now extinct, and it is difficult to conceive how the immense number necessary to make these mounds, could have found subsistence in so barren a region. An officer at Fort Dalles had one of the mounds excavated, but he found no trace of a burrow, nor anything else which could throw light upon its origin. They occur in vast numbers, upon the sides of steep hills as well as on plains, and the effect which they produce upon the landscape is not unlike that of the spots upon the skin of a deer.

Between Tysch creek and Fort Dalles, the character of the country undergoes a great change. Trap rock mostly gives place to marls. The road continually winds up and down steep, rolling hills, that are generally covered with fine bunch grass and destitute of trees. The valleys of the streams are all more or less settled, and they appear to be fertile and tolerably well supplied with timber, which is mostly oak. This section of the valley seems to be well suited to a pastoral population, but it can never compare, in fertility and importance, with that west of the Cascade Range. There are now two ferries across the Des Chutes river, one at its mouth and the other near Tysch creek.

Fort Dalles, the principal settlement in Oregon Territory east of the Cascade Range, is a military post and small frontier town on the southern bank of the Columbia, near the head of navigation. It is connected by a line of steamboats with Vancouver and the Willamette valley. It contains a few houses and stores, and will doubtless rapidly increase in size and importance, should the newly-discovered gold mines in Washington Territory prove profitable. A description of the Dalles of the Columbia will be found in Chapter V, under the date of September 10.

It will be seen that the Des Chutes valley is mostly a barren region, furrowed by immense cañons, and offering very few inducements to settlers. Its few fertile spots, excepting those in the immediate vicinity of Fort Dalles, are separated from the rest of the world by almost impassable barriers, and Nature seems to have guaranteed it forever to the wandering savago and the lonely seeker after wild and sublime natural scenery.

CASCADE MOUNTAINS, IN OREGON TERRITORY.

The Cascade Range, in Oregon, consists of a belt, from thirty to ninety miles in width, of pine and fir covered ridges, separated from each other by a network of precipitous ravines. A line of isolated volcanic peaks, extending in a direction nearly north and south through the Territory, rises from this labyrinth, and marks the extreme western border of the elevated plateau already described. The chief summits are Mount Hood, Mount Jefferson, Mount Pitt, and Diamond Peak; which, with the four buttes composing the group called the Three Sisters, tower high above the rest into the region of eternal snow, the lower limit of which is here about 8,000 feet above the sea. The other peaks, although quite prominent when seen from the plateau, are hidden by intervening ridges from the Willamette valley.

Westward from this line of volcanic peaks, an abrupt slope, mostly composed of ridges of very compact slate, separated by immense cañons, descends to fertile valleys, elevated but slightly above the sea level, and extending to the foot hills of the Coast Range.

Near the water-shed are numerous lakes, some of which discharge their waters towards the east, and others towards the west, by cañons so enormous that words fail to convey an adequate idea of their size. One, the side of which was so precipitous that we could only make the descent with the greatest difficulty, was found by actual measurement to be 1,945 feet deep.

A few small prairies covered with excellent bunch grass, lie hidden among the mountains. They are often surrounded by bushes bearing a kind of whortleberry, called "Oo-lal-le" by the Indians, who come in large parties in August and September to gather and dry them for winter use. Hence, it frequently happens that the explorer, while following a large trail which he hopes may lead across the mountains, suddenly finds it terminate in a whortleberry patch.

An examination of these mountains is very difficult. The ravines, filled with thick underbrush interlaced with fallen timber, are, many of them, utterly impassable; the ridges are very precipitous and rocky; generally the thick forest of pine, fir, spruce, and yew, quite conceals the surrounding country; and the great scarcity of grass for the animals is a source of constant anxiety. According to the best information which I could gather from Indians and settlers, the whole range is covered with snow during the winter.

There are six known passes through the Cascade Range, in Oregon Territory. It must be borne in mind that they are not simple gateways, but long winding courses through a labyrinth of ridges and ravines. They will be described in their order of succession, beginning at the most southern.

1. *Pass south of Mount Pitt.*—This pass, through which an emigrant wagon road has already been constructed, was not examined by our party. Lieutenant Williamson followed the road to the point where it enters the mountains, near Camp B, on Klamath river. It strikes Stewart creek, in Rogue River valley, not far from Camp 78 A. The air-line distance between these camps is only 32 miles, and the road is said to be very good, for a mountain route.

Pass south of Diamond Peak.—A wagon road has been constructed through this pass, also, by which Lieutenant Williamson crossed the range. The approach from the eastward is by a branch of Des Chutes river, that rises near the foot of the main ridge. About 20 miles after leaving this stream, the road strikes the middle fork of the Willamette river, the course of which it follows to the settlements. Where it passes over the main ridge, the road is very mountainous in its character, and in the ravine of the middle fork, it crosses the stream many times at deep and rocky fords. There is a scarcity of grass upon the route.

3. *New pass south of Mount Hood.*—This pass was discovered by the detached party in my charge. As I believe it to be more favorable for a wagon road than any of those previously known, I shall describe with considerable minuteness, both the pass proper, through the main ridge, and the approaches to it from the east and the west. This division is adopted simply for ease of description. By far the greatest difficulty in the passage of the range was encountered in the western approach to the pass.

About 20 miles south of Mount Hood there are two prominent peaks, called Nu-ah-hun by the Indians. At their northern base a remarkable depression is found in the main ridge. Near the western part of it there are two small lakes called Ty-ty-pa and Wat-tum-pa. The latter is the source of a branch of Tysch creek, which flows towards the east through the depression. From the point where we first struck this stream, to the lake, the hills slope gradually towards its bed, and there is no obstacle to the construction of an excellent wagon road, except the fallen timber. Between the two lakes there was a low hill, which could probably be avoided by following the course of a little tributary of Wat-tum-pa. West of Ty-ty-pa there was a steep rise of about 400 feet, conducting to the summit of the main ridge. I think this could be turned by keeping more to the north, but, at any rate, the ascent might be made very gradual by side location. The descent, of about 200 feet, into a great ravine, which borders the main ridge on the west, might be made without much difficulty. Through this entire pass, a distance of about 13 miles, a good road, almost free from hills, might be constructed by a little side cutting and the removal of a large quantity of fallen timber.

The eastern approach to this depression by my trail is excellent, and would require no labor of any kind, except a little side cutting and removal of logs in a place about 3 miles in length, between Wan-nas-see creek and Camp 58 A. There is not a single bad hill between Nee-nee springs and the entrance to the pass, a distance of about 24 miles. The distance from Nee-nee springs to Evelyn's rancho, on Tysch creek, which is the most southern settlement in Des Chutes valley, is about 19 miles; and a good road between them might be made with very little labor. It would cross the Mutton mountains by an open ravine, which one fork of the Indian trail now follows. This route, however, from the eastern entrance of the pass to the settlements, is very circuitous, and it is probable that a much shorter one might be found, either by following the branch of Tysch creek, flowing from Wat-tum-pa lake, or by taking an Indian trail which joined ours on Wan-nas-see creek, and which our guide said was very good. A similar description of it was also given to me by a half-breed, and its position, as indicated by him, is shown on the accompanying map. The almost inexhaustible supply of bunch grass near Nee-nee springs may, however, render the more circuitous route preferable.

The western approach to this pass is far less favorable than the eastern. An abrupt slope, furrowed by numerous cañons utterly impassable on account of fallen timber, conducts to the Willamette valley. To avoid the logs, we found it necessary to follow the dividing ridge between Clackamas and Sandy rivers, a route which is hardly practicable even for a pack train. From the source of Clackamas river, however, I could look down its ravine for more than 20 miles, and see the hills of the Willamette valley in the distance. The ravine appeared to be wide, straight, and free from lateral spurs; and I believe that a good road could be made in it by cutting through the logs. Near its head, it is connected with the great ravine bordering the main ridge, by a lateral cañon, into which we descended, and by which it is thought the road might reach the main ridge, in about 35 miles from Clackamas prairie, without encountering

any bad hill. The total distance from Clackamas prairie to Evelyn's rancho, by way of Nee-neé springs, is about 90 miles.

It is probable that a route might be discovered from my pass through the main ridge, to the present wagon road down Sandy river. If so, the great labor and expense of cutting through the logs in Clackamas ravine would be avoided.

A more minute description of the trail of my party across the mountains will be found in Chapter V, from October 5 to October 14, inclusive; but it must be remembered that fallen timber compelled me, during the latter part of the way, to follow a course very different from that proposed for the wagon road.

4. *Foster's Pass, south of Mount Hood.*—This pass, by which an emigrant wagon road now crosses the range, is named from the settler whose house stands nearest to it in the Willamette valley. The following information concerning it has been derived from reliable sources. Starting from the Willamette valley, a short distance north of Camp 64 A, the road follows up the ravine of Sandy river nearly to the main ridge. After leaving the stream it crosses the Range, between my new pass and Mount Hood, by a route so mountainous that heavily loaded wagons can travel only in one direction. It strikes Tysch creek, in Des Chutes valley, near Evelyn's rancho. For about 70 miles there is no grass near the road.

5. *Pass near northern base of Mount Hood.*—This pass is rarely used by any but Indians. I am told that it is very mountainous in its character, and that there is a great scarcity of grass near the trail. It is considered hardly practicable, even for pack animals.

6. *Columbia River Pass.*—I travelled down the Columbia, from Fort Dalles to the Cascades, in a small steamboat, and made a reconnaissance of the river between these points. The following brief description of this portion of the pass has been prepared from information thus obtained.

The Columbia river forces its way through the Cascade Range by a pass, which, for wild and sublime natural scenery, equals the celebrated passage of the Hudson through the Highlands. For a distance of about fifty miles, mountains, covered with clinging spruces, firs, and pines, when not too precipitous to afford even these a foothold, rise abruptly from the water's edge to heights varying from one to three thousand feet. Some of the ridges are apparently composed of compact basaltic conglomerate; others are enormous piles of small rocks, vast quantities of which have been known to slide into the river, overwhelming everything in their course. Vertical precipices of columnar basalt are occasionally seen rising from fifty to one hundred feet above the water's edge. In other places, the long mountain walls of the river are divided by lateral cañons, containing small tributaries and occasionally little open spots of good land liable to be overflowed at high water. It is difficult to conceive how the river could ever have forced its way through such a labyrinth of mountains.

About 40 miles below the Dalles, all navigation is interrupted by a series of rapids, called the Cascades. Precipitous mountains, from two to four thousand feet in height, close in upon the stream at this spot, leaving a narrow channel through which the water rushes with great violence. During high water, the river bed is only about 900 feet wide at the narrowest place. The descent at the principal rapid was shown by my barometric observations to be 34 feet, and the total fall at the Cascades to be 61 feet. These quantities, however, vary with the different stages of the water, as, when it is high, the obstructions in the channel act like a dam, and greatly increase the depth above.

An attempt formerly made to build a road round these rapids on the southern bank, entirely

failed, on account of the immense expense of the undertaking. The northern bank is favorable, and a portage, four and a half miles in length, has been constructed by the company owning the line of steamboats plying between the Dalles and Portland. Since my visit, this has been greatly improved by Lieut. G. H. Derby, United States Topographical Engineers, who has had charge of the construction of a military road from Vancouver to Fort Dalles.

Want of time compelled me to return to the Dalles without examining the river below the Cascades.

The following information relating to the navigation of the Columbia, I received from Captain W. B. Wells, the chief proprietor of the line of steamboats plying upon the river; a gentleman whose business has afforded him ample opportunity for observation. The river is at its lowest stage about the first of April, when it has a depth of between 9 and 10 feet up to the Cascades, and 9 feet thence to the Dalles. Above that point it is so much interrupted by rapids as to be unnavigable. It is highest about the first of July, when it has a depth of about 18 feet up to the Cascades, and of 39 feet thence to the Dalles. The disproportionate rise in the latter section is due to the stoppage of the water at the Cascades. There are no troublesome snags or floating timber at any time in the river, but often the shifting sand occasions trouble. The river very rarely freezes, and never for more than a day or two at a time.

As the Columbia has succeeded in forcing its way through the Cascade Range by this pass, it has naturally been supposed that a wagon road or a railroad could be constructed, at a moderate expense, upon its banks, and an appropriation of \$25,000 was made for the former purpose by Congress. The officer in charge of the work, Lieut. G. H. Derby, United States Topographical Engineers, made a careful examination of the route, subsequent to my reconnaissance, and he has reported the road impracticable, without enormous expense. I think that a careful survey would show the same to be true with reference to a railroad. At present, the only land communication down the river is by two pack trails, which leave the Dalles on the southern bank. Both are generally well supplied with grass. I was informed that one, which can only be used when the river is low, is tolerably good; but that the other continually crosses rough spurs, and winds along the face of precipices, by paths so narrow, that even mules sometimes lose their foothold. By both trails it is necessary to cross to the northern bank of the river, above the Cascades, where the current is strong and the river wide.

WILLAMETTE VALLEY.

This valley, which forms the richest and most populous portion of Oregon, lies between the Cascade mountains and the Coast Range. It is about one hundred and fifty miles in length, and fifty in breadth. Its general elevation above the sea level is from two to eight hundred feet. Some parts of it are well timbered with oak, maple, cedar, fir, spruce, arbor vitae, and other valuable kinds of trees; other portions are open and fertile prairies. The soil is generally very rich, and produces in abundance wheat, oats, barley, potatoes, and other products of the eastern States. Indian corn, however, cannot be cultivated to advantage. The Willamette river, flowing through the valley, receives many tributaries from the east and west, which furnish an abundant supply of water. The navigation of this river is interrupted by rapids, near Oregon city, about twenty-five miles from its mouth. At the season of high water, however, it is navigable for small steamboats, from the upper end of these rapids to Corvallis, a distance of about one hundred miles by the course of the river. Numerous flourishing towns, and a few cities, are located upon its

banks, and settlers' houses are now to be seen throughout nearly the whole of this beautiful valley, which has been appropriately called the Garden of Oregon.

Communication with the region east of the Cascade Range is principally carried on by small steamboats upon the Columbia river; but the pack trails upon the banks of this stream, and the wagon roads crossing the mountains near Mount Hood and Diamond Peak, are also used for this purpose. The land route to California is very mountainous, but a line of steamers connects Portland and San Francisco.

The climate of the valley is mild and salubrious. The following facts relating to this subject are taken from the Army Meteorological Register, published in 1855. The mean annual temperature is about 52° F.; that for the summer being about 65° F., and for the winter, 40° F. The mean fall of rain is, in the spring, 10 inches; in the summer, from 2 to 6 inches; in the autumn, 10 inches; and in the winter, 20 inches. The mean annual fall varies from 40 to 50 inches.

CALAPOOYA MOUNTAINS.

This name is given to a chain extending from the Cascade to the Coast Range, and separating the Willamette and Umpqua valleys. It is composed of low ridges, most of which are heavily timbered with spruce, pine, fir, and oak. A kind of hard sandstone is the prevailing rock.

There are three wagon roads across these mountains. Two of these, the Applegate and Scott roads, pass over high and steep hills. The third, which is located between them, and which was not fully completed when my party passed over it, follows Pass Creek through the mountains without encountering a single hill.

UMPQUA VALLEY.

The principal branch of the Umpqua river, called the South Umpqua, rises in the Cascade mountains near Diamond Peak. At first its course is westerly. In longitude about $123^{\circ} 15'$, it bends abruptly towards the north, and after flowing about 75 miles in this direction, and receiving the waters of the North Umpqua river and Elk creek, it again turns towards the west, and discharges itself into the Pacific. The most valuable and populous portion of the valley lies near the river where its course is northerly. This region consists partly of small open prairies, and partly of rolling hills sparsely covered with oak, fir, and other kinds of trees. Much of the land is exceedingly productive. The valley, at present, contains many scattered houses, but very few towns.

UMPQUA MOUNTAINS.

Little is known of this chain of mountains, except that it extends westward from the Cascade Range nearly to the ocean. It consists of ridges, from 2,000 to 3,000 feet in height, covered with thick forests and underbrush. The rocks are mostly talcose in character. The only road through the chain follows the Umpqua cañon, which is fully described in Chapter V, under the date November 1. Cow creek rises south of the mountains, and flows through them to the South Umpqua, but its cañon, although followed by a pack trail, is reported to be too narrow and precipitous for a wagon road. The chain has been crossed at other places by parties with animals, and it is not improbable that a good pass might be discovered by a thorough exploration.

ROGUE RIVER VALLEY.

Rogue river rises in the Cascade Range, near Mount Pitt, and flows westward to the Pacific ocean, receiving on the way numerous small tributaries from the Umpqua and Siskiyou mountains. Some of these streams flow through fertile valleys, separated from each other by high and forest-clad hills. Others, especially those near the coast, are sunk in immense cañons. Most of the rich land lies near the California and Oregon trail. Gold digging is profitable in many places. Hornblende and granitic rocks predominate, but Table Rock, and other hills in the vicinity, are basaltic. Jacksonville is at present the only town in the valley, although there are many scattered dwellings.

SISKIYOU MOUNTAINS.

Very little is accurately known about this chain, although it has been much explored by gold seekers. It is a high and heavily timbered dividing ridge between the waters of Rogue and Klamath rivers, and its general direction is east and west. The prevailing rock is a hard kind of conglomerate sandstone. Near the summit, elevated about 2,400 feet above the base, we found the soil to be an adhesive clay, which, when wet, renders travelling very laborious. There are several pack trails across the chain, but no reliable information concerning them could be obtained.

KLAMATH RIVER AND ITS TRIBUTARIES.

Klamath river, as already stated, rises in the great plateau east of the Cascade Range. After flowing through Klamath marsh, and upper and lower Klamath lakes, it breaks through the mountains, near Shasta Butte, and following the southern base of the Siskiyou chain, discharges itself into the Pacific. Through the greater part of its course, it flows either through sterile table lands, or immense cañons. Gold is found in many places upon its banks. My party, while returning to Fort Reading, passed through the valleys of Shasta, Scott's and Trinity rivers, three of its most important tributaries. These will be described in the order in which they were examined.

Shasta valley is an undulating region, about 25 miles in length and 15 in breadth, which extends from the base of Shasta Butte, in a northwesterly direction, to Klamath river. A small stream, named from the Butte, traverses it. This valley is sterile, compared with most of those already described, but the thick growth of bunch grass renders it a fine grazing country. It is for its gold, however, that it is chiefly valuable. This metal is found in large quantities; but mining is difficult on account of the scanty supply of water. To remedy this deficiency, the miners are now digging a ditch from a point near the source of Shasta river, along the base of the hills which bound the valley on the southwest, to the river again near where it discharges itself into the Klamath. This ditch, which is called the Yreka canal, will be, when completed, between 30 and 40 miles in length. It derives its name from the great depot of the northern mines, which is situated in so rich a portion of the valley that gold is dug in the very streets of the city.

Scott's river flows nearly parallel to Shasta river, being only about 18 miles further to the west. The character of its valley, however, is widely different. Gold digging is not generally profitable in it, although some rich mining claims have been discovered; especially at Scott's Bar near the mouth of the stream. Most of the land is very productive, and a large portion of the valley is

now divided into farms, the produce of which finds a ready market at Yreka and the mines. The greater elevation above the sea renders the climate much colder than that of the valleys further north. Frost has been known to occur here in every month of the year.

Trinity river rises near Mount Shasta, and, after making a great bend to the south, discharges itself into the Klamath river, of which it is the largest tributary. My party, starting from its head waters, followed down the stream for about one quarter of its length. It flowed through a deep ravine, bounded by high and timbered ridges. The bottom was so narrow that there was very little arable land. A short distance below the point where we left the river, it enters an immense cañon, which extends without much interruption to its mouth.

SHASTA BUTTE AND THE MOUNTAIN CHAINS OF NORTHERN CALIFORNIA.

Shasta Butte, by far the most striking topographical feature of northern California, rises abruptly to a height generally estimated at 18,000 feet above the sea. The peak is double, and both summits are rounded, massive, and loaded with eternal snow. Its white cloud-like form is distinctly visible from points in the Sacramento valley, more than one hundred miles distant.

This Butte is not only the largest and grandest peak of the long range which divides the sterile interior of the country from the fertile valleys of the Pacific Slope, but it is also a great centre, from which diverge the numerous chains that render northern California one mass of mountains. In approaching it by the Oregon trail, both from the north and the south, there is, independent of the high ridges, a gradual increase in the elevation of the country, for about 50 miles. The region near the base itself thus attains an altitude of about 4,000 feet above the sea; and it is an interesting fact, that most of the northern mines are found upon this vast pedestal of the giant Butte.

Great confusion exists in the nomenclature of the mountain ranges in the vicinity. The name, Cascade mountains, ceases at Klamath river, but the range in reality divides. One branch, called the Siskiyou mountains, bends westward nearly to the coast; the other, under the name of the Western Chain of the Sierra Nevada, winds to the southeast, and unites with the main Sierra Nevada. From the Butte, three steep and thickly wooded ridges called Little Scott's mountains, Scott's mountains, and Trinity mountains, extend to the westward. The two latter are branches of the Coast Range of California. Shasta Butte, although generally considered a peak of the Western Chain of the Sierra Nevada, is, in truth, the great centre from which radiate, besides several smaller ridges, the Cascade Range, the Coast Range, and the Western Chain of the Sierra Nevada.

CHAPTER II.

RAILROAD REPORT.

GENERAL SUMMARY.—PROPOSED RAILROAD ROUTE FROM BENICIA TO FORT READING.—PROPOSED RAILROAD ROUTE FROM FORT READING TO VANCOUVER, EAST OF THE CASCADE RANGE.—ROUTE FROM CAMP 36, NEAR THE HEAD OF DES CHUTES VALLEY, TO FORT DALLER.—ROUTE FROM THE DES CHUTES TO THE WILLAMETTE VALLEY, BY THE NEW PASS NEAR MOUNT HOOD.—PROPOSED RAILROAD ROUTE FROM VANCOUVER TO FORT READING, WEST OF THE CASCADE RANGE.

GENERAL SUMMARY.

THE detailed descriptions of the routes examined for a railroad will be prefaced by a few remarks upon the relation of the different lines to each other, and upon their general character.

The survey began at Benicia. From that place to Fort Reading, a distance of about 200 miles, but one route was examined. It lay through the fertile and settled valley of the Sacramento river, where bridges would form the only expensive item in the construction of a railroad. The supply of water and building material would be ample, and the average grade would not exceed 5 feet per mile.

Two routes, well supplied with water and building material, were examined, from Fort Reading to the Columbia river—one east and the other west of the Cascade Range. A brief description of each will be given.

1. *Route east of the Cascade Range.*—No insuperable obstacles were encountered on this route until the head of the Des Chutes valley was reached; but beyond that point it was utterly impracticable. A pass was examined, however, through the Cascade Range, near Diamond Peak, by which this valley could be avoided, and the Willamette river reached. The valley of this stream afforded a route to the Columbia river, very favorable to the construction of a railroad. This route from Fort Reading to the Columbia may be considered feasible. Its length is about 600 miles, of which 150 miles lie in a fertile and settled country, where the construction would be easy. The rest of the line traverses a wilderness, generally barren, and, for the most part, elevated from 4,000 to 5,000 feet above the sea. For about 200 miles of the latter section no very heavy work would be required, but for the remaining 250 miles the expense of construction would be very great. The chief obstacles would be encountered in crossing the western chain of the Sierra Nevada; in passing the two cañons of Pit river; in constructing the road along the shore of Upper Klamath lake; in following the cañon of Klamath river, between Upper and Lower Klamath lakes; and in crossing the Cascade Range to the Willamette valley.

It is thought that there would be danger of occasional obstruction from snow during a few months in the year, upon the portion of this route east of the mountains.

2. *Route west of the Cascade Range.*—The loss of the escort rendered it impossible to make any side examinations upon this line. Although the travelled route proved much better than had been anticipated, some portions of it were impracticable for a railroad. There are, however, good reasons for believing that by further examination these places could be avoided.

The length of the surveyed line was 470 miles. About 300 miles of it would be easy of construction, about 100 very costly and difficult, and about 80 impracticable at any reasonable expense. The routes by which the impracticable portions of the line could probably be avoided, will be fully explained in the detailed report. The chief obstacles would be encountered in passing from the Sacramento valley to Shasta valley, and in crossing the Siskiyou mountains, the Umpqua mountains, the Grave Creek Hills in Rogue River valley, and Long's Hills in Umpqua valley.

Should further examination show this route to be feasible, it would, for many reasons, be greatly preferable to that surveyed east of the Cascade Range. It traverses a region generally but little elevated above the sea, where the danger of obstruction from snow would be very much less than upon the high plateau east of the range. It passes through the richest and most populous portion of Oregon, while a large part of the other traverses a sterile, uninhabited waste. Besides the great amount of way travel always created by a railroad in a settled country, much freight would probably pass over this line, which would not be transported over the other. This is evident from the following considerations. There are in the Willamette, Umpqua, and Rogue River valleys areas of very productive land, which is uncultivated only because there is no market for the produce. No large rivers afford water communication with the ocean, and the mountains, which cover northern California, almost entirely prevent the transportation of supplies, by land, to that State. Oregon is, therefore, to a great extent, isolated, and dependent upon itself for a market. The construction of a railroad to the Sacramento valley, by this route west of the mountains, would enable the farmers in all these fertile valleys to send their produce to the mining regions of northern California and southern Oregon, where most of the country is unfitted for agricultural purposes, and where the price of provisions is now most exorbitant. The route east of the Cascade Range, on the contrary, would neither be accessible to freight from southern Oregon, nor traverse the mining region, where the most profitable market for the produce of the Willamette valley would be found.

The remainder of this chapter contains detailed descriptions of the different routes explored.

PROPOSED RAILROAD ROUTE FROM BENICIA TO FORT READING, SURVEYED BY LIEUT. WILLIAMSON.

Before Lieutenant Williamson's sickness, he had prepared the following report upon the route up the Sacramento valley. As he never revised it, I have made a few necessary verbal corrections, but have not, in the slightest degree, changed its import. It is to be considered entirely his report.

"The Sacramento valley is a vast plain, about two hundred miles long, and averaging fifty miles in breadth. Through the middle of it flows the Sacramento river, receiving numerous tributaries from the Sierra Nevada, but very few from the Coast Range. The valley is destitute of trees, except upon the river banks, and is covered with a luxuriant growth of wild oats. The soil, during the summer, is very dry, but in winter is so moist as to render travelling very difficult. There is not the slightest topographical obstruction to the construction of any kind of a road, in any part of the valley.

"In the examination of the valley, therefore, with reference to the construction of a railroad, the most important question seems to be the relative advantages presented by the east and west sides of the valley. I had previously been up and down the valley, on each side, and was well acquainted with its character.

"Only a very small quantity of water is drained from the eastern slope of the Coast Range; and most of that is absorbed by the soil at its base. Hence the almost total absence of tribu-

aries, received by the river from the west, until we arrive near the head of the valley. The banks of the river, on that side, are generally bluff and unbroken; the east side, on the contrary, is intersected by numerous streams, coming from the Sierra Nevada; some, large enough to be entitled to the name of rivers; others, so inconsiderable as to be passed unnoticed by the traveller, in summer. These, however, are torrents in winter, and form an important item for consideration, in making a road.

"The distance from Benicia to Fort Reading, by the western side of the valley, by the ordinary road, which is very direct, is 178 miles; while by the eastern side, it is 200 miles. The former portion, however, is only inhabited along the banks of the river, whereas the tributaries from the Sierra Nevada, intersecting the latter portion, afford plenty of water, and numerous desirable locations for farms. The mining portion of the population is all on this side, and branch roads into the mines would be required. In order, therefore, to afford the means of discussing understandingly the relative advantages of these two portions, I determined to proceed to Fort Reading by the eastern side of the valley, and note particularly, the size and character of the beds of the water-courses that intersect it, that the extra expense of construction due to bridging, might be estimated.

"We left our camp near Benicia, on the 10th of July, and travelled thirteen miles, camping on a small stream known as Suisun creek, which is about thirty feet wide. This is the first place where a bridge would be required. From here we travelled on through the Suisun valley, by a road nearly level, but occasionally passing through low, rolling hills, until, thirty-two miles from Benicia, we came to Potos creek, which is a stream sixty or seventy feet wide. When we crossed it, the water in the creek was thirty feet below the top of the banks; but in winter it sometimes overflows them. This stream, at the most favorable point, would require a bridge 130 feet long.

"The only other stream, before reaching the Sacramento river, is Cache creek, which differs from Potos creek in occupying a broad bed with low banks. At the narrowest place I saw, the bed was 100 yards wide, with banks thirty feet high, and I am told that in time of freshet these are overflowed. Thus, but three bridges would be required between Benicia and the Sacramento river, and, if the road followed up the west bank, none other would be required for sixty miles. Above that, the river receives a tributary every fifteen or twenty miles.

"We crossed the Sacramento river at Frémont, a town of half a dozen houses, opposite the mouth of Feather river. The Sacramento was low, and 250 yards wide. In time of high water when the banks are not overflowed, it is 300 yards wide, but in time of freshet the country is overflowed for miles. I came down the river in December, 1852, when the sheet of water covering the country was fifty miles broad. Vast quantities of stock were destroyed. Sacramento city was overflowed, and much damage done to property there.

"From the crossing of the Sacramento, we travelled up the eastern side of the valley, all the way to Fort Reading, following Feather river for nearly fifty miles. The country was a level plain until within forty miles of the fort, when it assumed an undulatory character, but presented no serious obstacle to the construction of a railroad. The average grade from Benicia to the fort, is 2.6 feet per mile.

"In order to show the amount of bridging required for a road going up on the eastern side of the valley, I have constructed the following table, which gives a concise description of every stream crossed. This table includes all those which are dry in summer, but which must be bridged to allow a free passage for the water in winter. The height of the banks is given for low water."

Water-courses north of Frémont, on the route surveyed up the Sacramento valley.

Name of stream.	Dist. from Frémont.	Length of bridge.	Remarks.
	<i>Miles.</i>	<i>Feet.</i>	
Sacramento.....		300	Banks 30 feet high.....
Coon creek.....	13.8	35	Banks 10 or 12 feet above water.....
Bear creek.....	17.9	30	Banks low.....
Yuba river.....	29.4	200	Banks 30 feet high. Bluffs.....
Feather river.....	30.1	250	Well built wooden bridge.....
Dry gully.....	56.0	75	.....
Dry gully.....	58.0	25	.....
Dry gully.....	59.7	12	.....
Dry gully.....	61.7	12	.....
Dry gully.....	63.0	10	.....
Dry gully.....	64.4	10	.....
Dry gully.....	64.6	15	.....
Dry gully.....	66.1	15	.....
Butte creek.....	66.8	50	Banks low.....
Little Butte creek.....	70.3	20	.....
Dry gully.....	70.8	30	.....
Dry gully.....	73.7	10	.....
Chico creek.....	74.1	30	Banks 25 feet above water.....
Dry gully.....	75.5	20	Banks low.....
Dry gully.....	75.9	10	Banks low.....
Dry gully.....	78.5	12	Banks low.....
Dry gully.....	80.5	18	Banks low.....
Dry gully.....	81.2	40	Banks low.....
Dry gully.....	85.9	10	Banks low.....
Dry gully.....	86.4	12	Banks low.....
Dry gully.....	87.1	50	Banks low.....
Dry gully.....	88.2	40	Banks low.....
Dry gully.....	90.0	20	Banks low.....
Dry gully.....	91.3	12	Banks low.....
Dry gully.....	92.1	10	Banks low.....
Dry gully.....	92.9	30	Banks low.....
Deer creek.....	93.4	50	Banks low.....
Dry creek.....	93.6	15	Banks low.....
Dry creek.....	96.4	30	Banks low.....
Dry creek.....	97.1	20	Banks low.....
Mill creek.....	101.1	60	Banks low.....
Mill creek slough.....	102.1	40	Banks low.....
Dry gully.....	102.2	40	Banks low.....
Dry gully.....	104.1	10	Banks low.....
Dry bed.....	104.9	30	.....
Dry bed.....	106.2	8	.....
Dry bed.....	107.4	15	.....
Antelope creek.....	107.7	45	.....
Gully with water.....	108.1	30	.....
Gully with water.....	110.4	36	.....

Water-courses—Continued.

Name of stream.	Dist. from Frémont.	Length of bridge.	Remarks.
	<i>Miles.</i>	<i>Fet.</i>	
Slough.....	112.2	20	} These three sloughs are close together and dry.....
Slough.....	112.2	10	
Slough.....	112.2	15	
Creek with water.....	113.4	25	Name not known.....
Dry gully.....	113.7	90	.....
Dry gully.....	111.9	60	.....
Dry gully.....	111.9	30	.....
Dry gully.....	115.8	50	.....
Seven Mile creek.....	118.7	25	.....
Beaver creek.....	122.4	30	.....
Liver creek.....	129.8	20	.....
Battle creek.....	134.3	50	Near junction with Sacramento.....
Bear creek.....	137.9	20	.....
Cow creek.....	140.3	50	Fort Reading.....

PROPOSED RAILROAD ROUTE FROM FORT READING TO VANCOUVER, EAST OF THE CASCADE RANGE
SURVEYED BY LIEUTENANT WILLIAMSON.

In preparing the following description of this route, I have been careful to express Lieutenant Williamson's ideas, as far as they are known to me. As, however, he seldom referred directly to the railroad, in his journal, I have sometimes been unable to ascertain definitely what his opinion was. In such cases, I have given my own.

With the exception of the Willamette valley and a small portion of the Sacramento valley, the regions traversed by this route are unsettled, and, as a general thing, barren in their character. The rocks are chiefly of volcanic origin. The few fertile spots are usually difficult of access, and the country is unfitted to support a civilized population.

Of the climate of the region east of the Cascade Range, traversed by this route, we have no definite knowledge, founded upon long continued observations; but it is well known that little or no rain falls during several months of the year, and that the whole region is often covered with snow in the winter. Colonel J. C. Frémont, in traversing it during the winter of 1843-44, found the snow occasionally three feet in depth, and the climate severe. In the latter part of August, water froze at night in our camps near the head of Des Chutes valley, at an elevation of only about 4,200 feet above the sea. In my opinion, there would be danger of occasional obstruction from snow, during a few months in the year, should a railroad ever be constructed on this plateau.

The supply of water, fuel, and building materials is almost unlimited, upon the whole route. The only place where there is any deficiency of timber in the immediate vicinity of the trail, is near Lost river and Rhett lake, and there it can be easily obtained from the neighboring hills. There is no lack of water, or good building stone, at any point upon the line. It only remains to describe the difficulties of actual construction. The grades will not, as a general thing, be mentioned in this report, as those upon the travelled route are given on profile No. 1, sheet No. 1, and those upon the proposed railroad line, on profile No. 2, of the same sheet, and also in

Appendix F. In constructing the latter profile, I have generally included the windings of the trail in the estimate of distances between stations. This has been done, partly because it would be impossible, in much of the region traversed, to speak with certainty of any of the country not actually passed over; and partly, because the winding necessary to obtain uniformly easy grades, would generally render it impossible to materially diminish the travelled distances, although the general direction of the line might be more direct.

The first obstacle encountered after leaving Fort Reading, was the western chain of the Sierra Nevada. As Lieutenant E. G. Beckwith, 3d artillery, had surveyed in 1854, and reported favorably upon the Pit river pass, or, as he terms it, the Upper Sacramento river pass, through this chain, Lieutenant Williamson deemed it unnecessary to make any re-examination of it. He, therefore, took the more direct route by Noble's Pass to the plateau east of the mountains. Our profile of this pass does not differ very materially from that of Lieutenant Beckwith, who also examined the route; but our barometric observations show the altitude of the summit to be 186 feet greater, and the altitude of Fort Reading to be 107 feet less, than was stated in his report. These discrepancies may be easily explained, as Lieutenant Beckwith was unable to obtain any correction for the abnormal oscillation of the barometric column, a correction which sometimes exceeds these differences in amount. Noble's Pass is certainly very unfavorable for a railroad, and I think that Lieutenant Williamson considered it impracticable, without a tunnel. The line down Canoe creek valley to Pit river, would also involve some very expensive work and heavy grades; as will be seen by reference to the profile of our travelled route. In constructing the profile of the proposed railroad line, I have, therefore, adopted the route surveyed by Lieutenant Beckwith, from Fort Reading through the Pit river pass to the mouth of Canoe creek. Lieutenant Beckwith considers this route practicable, although it involves some very heavy work. A detailed description of it will be found in his report, which is contained in Vol. 2 of this series.

A short distance above the mouth of Canoe creek, the river passes through a cañon, 4.5 miles in length. The sides are so steep and so near the water, that Lieutenant Williamson was unable to enter on foot, at its mouth. His description of it will be found in Chapter III, under the date August 5. He considered it impracticable to construct a railroad through it, at any reasonable expense, on account of the vast amount of rock cutting and tunneling, which would be required. The distance between Camps 19 and 20, which were situated near the water level at the lower and upper ends of this cañon, was, by the course of the stream, 7.5 miles. The difference in their elevation was 520 feet. Hence the descent of the stream, and consequently the grade in the cañon, must be at least 69 feet per mile.

Although the pass which I examined through Stoneman's ridge, was unfavorable for a railroad, it is considered preferable to the cañon. By side location, the road could pass from Camp 19 to the foot of the main ridge, a distance of 3.5 miles, with an ascending grade of 168 feet per mile. It would then follow up the ravine for 2.3 miles, with a grade of about 200 feet per mile. A tunnel, half a mile in length, through trap rock would then be advisable; although, by very heavy grades, and winding to increase distance, it might probably be avoided. A descent of 89 feet would be required in the tunnel, which would pass 303 feet below the summit of the ridge. From the eastern entrance, the road, by side location, could reach Camp 20, with descending grades of 200 feet per mile for 0.8 of a mile, and 63 feet per mile for 4.4 miles.

The route examined between the two cañons, traversed a slightly undulating plain, and no

heavy grades or expensive work would be required. In the last few miles, however, considerable cutting through trap rock might be necessary.

Lieutenant Williamson's notes on the upper cañon of Pit river, will be found in Chapter III, under the date August 7. He considered it practicable to construct a railroad in this cañon, at a reasonable expense; although much heavy rock cutting and numerous short curves would be required. The ascending grade would be 76 feet per mile, for the whole distance of 9.9 miles; and it is probable that numerous bridges would be necessary. It is my opinion, that a better location would be found, by further examination, upon the northern bank of the river. The trail, although very rocky in places, is generally good, and the hills are low. Although the river descends about 750 feet, from a higher to a lower terrace, in this cañon, I think that by proper side location, the necessary ascent might be made, and a line conducted round the cañon on this bank, with grades never exceeding 200 feet per mile. The expense of construction would probably be very much less than by the cañon route.

The road would next cross Round Valley to Camp 23. No difficulty of any kind would be encountered in this section.

Between Camps 23 and 24 the country was hilly, and considerable heavy cutting through cellular trap would be necessary. It is highly probable that the spring branch upon which Camp 24 was situated, discharges into Pit river. If so, the railroad should follow up its course.

Between Camps 24 and 25, the only serious obstacle would be the low ridge which borders Wright lake. It is very probable that these hills could be turned by passing to the west of Wright lake, and striking Rhett lake at once; but as this line was not examined, I have represented on the railroad profile the route by Wright lake, with the grades which could be readily obtained by side location, and an increase of distance of 2.5 miles. The railroad would gain the summit, with an ascending grade of 150 feet per mile for 3.5 miles, by winding towards the east, at the foot of the ridge. It would then descend to Camp 25, with a grade of 150 feet per mile, for 3.5 miles.

The first ridge crossed after leaving Camp 25, could be turned, with an increase of distance of about one mile, by locating the road further towards the north.

The next obstacle of importance, was the steep descent to the shore of Rhett lake. This could be overcome by winding towards the south, with a grade of 200 feet per mile, for one mile.

The road would then traverse a flat plain, to the Natural Bridge of Lost river. The stream, which is here deep and sluggish, is about 80 feet in width, with banks but little elevated above the water surface. A description of the Natural Bridge will be found in Chapter III, under the date August 13. Whether the stone arches are sufficiently strong to support a railroad, can only be ascertained by careful examination and measurement. Loaded wagons now cross, without danger. Trap rock and pine timber, for construction, could be readily obtained from the neighboring hills.

From the Natural Bridge to Upper Klamath lake, the only expensive work would be encountered in passing the low ridge which borders the lake on the south. A short cut of 23 feet, through trap rock, would be required. It is probable, that a portion of the upper part of Lost river valley, is occasionally submerged, in the rainy season, by water from the lake; but I think, that a location could be easily found, which would avoid this danger.

The railroad would next follow the lake shore to the point where our trail left it. Consider-

able heavy cutting through trap rock, and a few short bridges over springs and small arms of the lake, would undoubtedly be necessary.

The valley of Klamath river could be followed without expensive work, to the entrance of the cañon. This cañon, which is four miles in length, is a formidable obstacle, and would require an amount of cutting through trap and pumice-stone, which can only be estimated by a detailed examination. Lieut. Williamson expressed to me his opinion, that the route was practicable, but very expensive. A description of this cañon will be found in Chapter III, under the date August 20.

From the northern end of the cañon to Camp 34, the country is nearly level; and the only difficulty would be to guard against an overflow of the waters of Klamath marsh, in the rainy season. A bridge, about 150 feet in length, would be necessary to cross Klamath river, for which an abundance of pine timber could be easily obtained.

From Camp 34 to Camp 35, the route was very favorable for the construction of a railroad. Thence to Camp 36, on Des Chutes river, no very expensive work would be necessary. The country, however, is undulating, and a large amount of cutting and filling through pumice-stone, and occasionally through trap rock, would be required. Of this portion of the route, Lieut. Williamson writes in his journal: "There is a dividing range not of mountains, but of hills, between Klamath marsh and the Des Chutes river. There are, apparently, several low places to cross it, through one of which the trail runs. There appears to be no topographical obstacle to the location of a railroad. The main difficulty would be the extreme lightness of the soil."

I crossed the Cascade Range by a different pass from Lieut. Williamson, and did not, therefore, traverse the remaining portion of this proposed railroad line, myself. I have, however, often conversed with Lieut. Williamson about it, and the following description is based entirely upon information thus obtained, and upon his recorded field notes.

From Camp 36, the railroad would follow up the branch of Des Chutes river, to Camp 44 W. The valley is open, and the construction would be easy for the whole distance.

The grades upon the route followed by Lieut. Williamson, from Camp 44 W. to Camp 45 W., were impracticable for a railroad, as will be seen by referring to profile No. 1, sheet No. 1. From the highest point of the pass, however, he could overlook the country towards the south, and see a route which he considered perfectly feasible. The dense forest, rising from a tangled mass of underbrush and fallen timber, rendered it impossible for him to actually traverse this route; but he was fully satisfied that practicable grades could be obtained without tunneling. He often expressed to me his opinion, that the immense amount of fallen timber would be the greatest obstacle encountered in constructing a railroad through the pass. He indicated the following course for the proposed railroad line. It would follow up the branch of Des Chutes river, and gain the summit of the main ridge, between two prominent peaks east of the lake which forms the source of the Middle Fork of the Willamette. The altitude of the summit appeared to be considerably less than it was where he crossed the ridge, but, as he had no means of estimating the difference with accuracy, he thought it best to assume, on the profile, the same altitude. The grades in reality, therefore, are rather more favorable than represented on profile No. 2, sheet No. 1. From the summit, the line would descend by side location to the lake, and then follow down the Middle Fork to the vicinity of Camp 45 W. Both the eastern and western sides of the ridge appeared to be free from small ravines, so that a side location could be made without great expense in cutting and filling; but Lieut. Williamson appre-

hended great difficulty in following the Middle Fork from the lake to where his trail struck it. His notes upon the pass will be found in Chapter IV, under the date September 29.

From Camp 45 W to the Willamette valley, the railroad would follow the course of the Middle Fork. Occasional heavy cutting through lateral spurs would be required, but no very costly work.

A discussion of the facilities offered for the construction of a railroad in the Willamette valley, will be given in connection with my return route from Vancouver to Fort Reading.

ROUTE FROM CAMP 36, NEAR THE HEAD OF THE DES CHUTES VALLEY, TO FORT DALLES. SURVEYED BY LIEUT. ABBOT.

As the route down the Des Chutes valley to the Columbia river is considered utterly impracticable for a railroad, it is deemed only necessary to state the grounds upon which this opinion is based. The whole difficulty consists in obtaining suitable gradients. The supply of water is abundant, and good timber for ties and fuel can always be obtained, at a slight cost, from the neighboring mountains, when it is not found near the trail.

The road could be built at a moderate expense, with a descending grade of 13 feet per mile, from the place where we first reached the Des Chutes river, to the point where my party rafted it, a distance of about 29 miles. The stream was here about 150 feet wide, and flowed with a rapid current over a rocky bed. It could have been forded, but not without wetting the packs. The nature of the banks would render it necessary that a bridge should be at least 200 feet in length. A short distance below this point, the river enters the great cañon. It is not considered practicable, without enormous expense, to construct a railroad from this place to the Dalles, either in this cañon, or upon the eastern or western side of the valley. The obstacles to be encountered on each of these three routes will be briefly stated.

The cañon, which in many places is more than 1,000 feet in depth, extends, without doubt, to the mouth of the river; a distance of about 140 miles. It abounds in rapids and short bends, which would render numerous tunnels and deep cuts through a kind of basaltic rock of exceeding hardness, indispensable. There would also be constant danger of avalanches of earth and stone, from the precipitous sides. The average descent of the river in the cañon, is about 25 feet per mile.

Of the eastern side of the valley below the rafting place, comparatively little is accurately known. Much of it appears, when seen from a distance, to be a bare, sterile plateau, some portions of which are level, and others broken by rolling hills. As the river undoubtedly receives most of its tributaries from the Cascade Range, it is possible that the numerous lateral cañons, which furrow the western bank and render it impracticable for a railroad, might not be encountered on the eastern. But, even if this should prove to be the case, in order to reach the navigable portion of the Columbia river, it would be necessary to cross the Des Chutes cañon by an embankment or bridge, nearly a mile in length and from 500 to 1,000 feet in height, and then, before reaching the Dalles, to overcome other obstacles involving equal expense.

The western side of the valley was thoroughly explored by my party. As insurmountable difficulties were subsequently encountered, it is sufficient to state of the section extending from the rafting place to Camp S on Why-chus creek, a distance of about 34.4 miles, that the construction of a railroad through it would be rendered very expensive, by the necessity of crossing numerous ravines from 100 to 200 feet deep, and of cutting through several high, rocky spurs. An average descending grade of 26 feet per mile, would be required. The country north of Why-chus creek was very carefully examined, both near the river and near the mountains. The best

route which could be found for a railroad, lay through a level prairie around the western base of a prominent conical butte, to the cañon of Mpto-ly-as river; which could be entered by a wide, open ravine. This stream, the cañon of which is the first impassable obstacle to the road, rises among the peaks south of Mount Jefferson. After flowing towards the north for a few miles, it takes an easterly course, and discharges itself into the Des Chutes. The depth of its cañon varies from 800 to 2,000 feet, and the width at the top, from two miles to half a mile. There is no pass between it and Mount Jefferson. It would be necessary, after entering the cañon from the south, to keep up the grade by locating the railroad high upon the eastern side, although there would be many small lateral ravines to bridge. After about 18 miles of this difficult and very costly construction, it would be necessary to cross the river, near its most northern point, by an embankment about a mile long, and 1,200 feet high; and thus reach the top of the great basaltic plateau. A line from the snowy summit of Mount Jefferson, eastward to the Des Chutes river, was carefully examined; and this is the best route to this plateau which could be found. It is thought, that the impracticability of the road is made sufficiently manifest, by stating without further detail, that by the most favorable location from this point to the Dalles, a distance of about 75 miles, there would be, beside smaller obstacles, seven cañons to cross, similar to that of the Mpto-ly-as river although not quite so deep, and a difficult spur from the Cascade Range, called the Mutton mountains.

By this description it will be seen, that, at the head of the Des Chutes river, the railroad coming from the south, should either cross the Cascade Range to the Willamette valley, or bend towards the east, and, avoiding entirely the Des Chutes valley, reach the Columbia, above the head of navigation, by some as yet unexplored route.

ROUTE FROM THE DES CHUTES TO THE WILLAMETTE VALLEY, BY THE NEW PASS NEAR MOUNT HOOD.
SURVEYED BY LIEUTENANT ABBOT.

The most unfavorable feature of this route for a railroad, is the difficulty of access to the new pass. To reach it on the western side of the Des Chutes valley, either from the north, or the south, is utterly impracticable. As, however, it appears to be a better railroad pass through the Cascade Range, than any surveyed further south; and, as there is a bare possibility that it may be reached from the eastern side of the valley, it is deemed advisable to describe it with considerable minuteness.

The crossing of the Des Chutes cañon would be a most difficult and costly undertaking; but, if it could be accomplished near the Mutton mountains, I think Nee-nee springs might be easily reached. Between that point and the pass, a distance of 24.3 miles, no great obstacle would be encountered. The grade is less than 100 feet per mile, except at three places, where it is for half a mile 206 feet, for two miles 141 feet, and for one mile 125 feet, per mile. At these points it could be easily reduced, by side location, to 100 feet per mile.

From the entrance of the pass, the line would follow the course of a branch of Tysch creek to Wat-tum-pa lake, a distance of 6.2 miles, with an ascending grade of eighty-five feet per mile. A little side cutting, and the removal of a great number of logs, would be requisite in this section. West of the lake the trail passed over a steep hill, which could be avoided by following the course of a small tributary. Ty-ty-pa lake could thus be reached with an ascending grade of 109 feet per mile, for 3.8 miles. The trail next passed over a steep ridge which formed the true summit of the pass. Its altitude above the sea level, was 4433 feet. The ascent from Ty-ty-pa lake to the summit, by the trail, was 416 feet; and the descent to a great ravine, about 200 feet. It is thought that this ridge might be crossed at a much lower point, a little further

to the north, but, even if this should not prove to be so, both the ascending and descending grades could be reduced, by side location and an increase of distance, to less than 200 feet per mile. This could be easily done, as the ridge is not furrowed by many ravines. The removal of a large quantity of timber would be the principal difficulty.

From the summit of the pass to the Willamette valley, the railroad would follow a route which we could not travel over, on account of an immense number of logs that completely blocked up the way. We passed along ridges, however, from which we could overlook it, and see that the fallen timber was probably the only serious obstacle. The great ravine extending north and south could be crossed, and Clackamas ravine entered by a lateral cañon and followed, apparently without any obstruction from bends or side spurs, to the valley. The approximate distance would be thirty-eight miles, and the approximate grade, for most of the way, 125 feet per mile. It would be less than this, near the summit.

Throughout the whole distance, the supply of timber, water and stone is abundant. Occasionally a little heavy rock and earth cutting would be required, but the chief difficulty, in preparing the road bed, would be to clear away the mass of timber, logs, and underbrush, which now renders portions of the route utterly impassable. During the winter, it is probable that the pass is blocked up with snow, to a depth of 20 or 25 feet, but concerning this, nothing is known with certainty.

PROPOSED RAILROAD ROUTE FROM VANCOUVER TO FORT READING, WEST OF THE CASCADE RANGE. SURVEYED BY LIEUT. ABBOT.

The party which examined this route, was deprived of its escort, by the officer commanding the Columbia River and Puget Sound District. As this loss caused the survey to be made under great disadvantages, and prevented certain important side explorations, it has been deemed proper to state, in full, the circumstances of the case, and to give a detailed account of the Indian disturbances, which greatly embarrassed the party in the performance of the duties assigned to it by the War Department. This has been done in Chapter V, under the date October 19, and between the dates October 30 and November 5, inclusive.

The result of the survey showed the route to be much more favorable to the construction of a railroad, than had been anticipated, and, although certain portions of the line actually examined were found to be very unfavorable, it is thought that a way to avoid these places would have been discovered by further exploration, had not this been prevented by the loss of the escort.

The climate of the regions through which this route passes, is mild. The mean winter temperature, for the two years 1853 and 1854, was 33°.78 Fah., at Fort Jones, which is situated upon the coldest portion of the line. At Fort Reading, for the same years, it was 46°.12 Fah., and at Fort Vancouver, for the four years, 1850, '51, '52, '53, it was 39°.54 Fah. This information is derived from the Army Meteorological Register, published in 1855. Unpublished records of the medical department show that the mean temperature at Fort Lane, for the winter of 1856, was 38°.89 Fah. It appears from these data, that, should a railroad be constructed upon this route, there will be little danger of serious obstruction from snow.

An unlimited supply of wood, water and stone, for railroad purposes, is found in the immediate vicinity of this line, throughout its whole extent. It only remains, therefore, to consider the route with reference to the actual difficulties of construction.

It may be well to state, that, as the grades upon the route travelled are given on profile No. 1,

sheet No. 2, and those upon the proposed railroad line, on profile No. 2, sheet No. 2, and in Appendix F, they will not, as a general thing, be repeated in this report.

For about 150 miles after leaving the Columbia river, the route lies in the Willamette valley. This region is admirably adapted to the construction of a railroad. The surface is level, or gently undulating, the streams, although numerous, are small, and the settled character of the country would render it easy to obtain supplies of every kind for the working parties. An average grade of about ten feet per mile would be required, and it is thought that the maximum grade would not exceed fifty feet per mile. Two routes from Oregon City to Eugene City were examined: Lieut. Williamson followed the hill road, upon the eastern side of the valley; I took the most direct road from Oregon City to Salem, and after crossing the Willamette at that point, passed up its western side. Although it would be perfectly practicable to construct a railroad in the immediate vicinity of either of these routes, a better location could, without doubt, be found between them on the eastern bank of the river.

The following tables give an approximate idea of the amount of bridging necessary upon each of the surveyed lines.

Table of water-courses in the Willamette Valley, upon Lieutenant Abbot's route.

Name of stream.	Distance from camp near Vancouver.	Length of bridge.	Remarks.
	<i>Miles.</i>	<i>Feet.</i>	
Slough	1	30	Banks 15 feet high.
Creek	12	30	Banks 20 feet high.
Small creek.....	14	10	Banks low.
Clackamas river	18	130	Banks 30 feet high.
Small creek.....	25.5	10	Banks low.
Small creek.....	25.6	10	Banks low.
Mollalle river.....	30	80	Banks 30 feet high.
Small creek	34.3	10	Banks low.
Pudding river	36.5	70	Banks 20 to 30 feet high. Bridge.
Slough	49.6	40	Banks 20 feet high, with gradual slope.
Marsh	52.7	600	Banks miry.
Small creek.....	60	40	Banks 20 feet high.
Willamette river	60.7	300	Banks 40 feet high, with gradual slope.
La Creole river.....	66.3	20	Banks low.
Small creek.....	71	10	Banks low. Bridge.
Lackimute river	77	40	Banks 40 feet high. Steep.
Slough	82	10	Banks low.
Mary's river	94	60	Banks 20 feet high, with gradual slope.
Long Tom creek.....	108.5	50	Banks 30 feet high. Bridge.
Small creek.....	154.6	10	Banks low.
Small creek.....	155.3	10	Banks low.

Table of water-courses in the Willamette Valley, upon Lieutenant Williamson's route.

Name of stream.	Distance from camp near Vancouver.	Length of bridge.	Remarks.
	<i>Miles.</i>	<i>Fet.</i>	
Slough	1	30	Banks 15 feet high.
Creek	12	30	Banks 20 feet high. Bridge.
Creek	14	10	Banks low.
Clackamas river	18	130	Banks 30 feet high.
Small creek	23.2	10	Banks low.
Small creek	25.3	5	Banks low.
Mill creek	28.6	20	Banks 10 feet high.
Mollalle river	31.0	60	Banks low.
Main Rock creek	37.4	-----	
Branch of Rock creek	39.5	10	Banks 8 feet high.
Butte creek	41.8	10	Banks low.
Alberqua creek	44.4	40	Banks 20 feet high.
Small creek	45.6	15	Banks low.
Silver creek	46.6	100	Banks 15 to 20 feet high. Bridge.
Small creek	50	10	Banks low.
Small creek	50.8	20	Banks low.
Small creek	52.1	10	Banks low.
Small creek	54.3	10	Banks low.
Small creek	58.2	5	Banks low.
Slough	64.3	25	Banks 10 feet high.
Small creek	64.6	15	Banks low.
Small creek	64.7	10	Banks low.
North fork of Santiam river	64.8	130	Banks 15 feet high. Bluffs.
Thomas Fork	69.4	60	Banks 20 to 30 feet high. Bridge.
Crabtree creek	72.4	50	Banks 20 to 30 feet high. Bridge.
South Beaver creek	73.5	10	Banks low.
South fork of Santiam river	75.3	100	Banks low.
Slough	81.5	-----	Banks low.
Small creek	89.9	20	Banks 10 feet high. Bridge.
Calapooya creek	91.8	15	Banks 15 to 20 feet high.
Dry gully	98.7	10	Banks low.
Mud creek	103.0	20	Banks low.
McKenzie's Fork	112.3	120	Banks low. Spore's Ferry.
Slough	112.4	25	Banks low. Bridge.
Middle Fork at Eugene City	117.8	about 100	

The distance from the camp opposite Vancouver, to Camp 71 A. near the head of the Coast Fork of the Willamette, is, by my route, 157.5 miles, and by that of Lieut. Williamson, which joins mine at Eugene City, 142.8 miles. There are a few low hills upon each of these lines, but, as a railroad could be located between them over an almost level plain, a more detailed description is not considered necessary.

The Willamette and Umpqua valleys are separated by the Calapooya mountains. An excellent pass was found through this range. From Camp 71 A. the line would follow up a small

branch of the Coast Fork of the Willamette to a little meadow, elevated 863 feet above the sea. This meadow is also the source of a small tributary of the Umpqua river, called Pass creek. The railroad would follow the course of this stream through the Calapooya mountains. Several short bridges would be required, with a little cutting through earth, and, for a few feet, through a hard kind of sandstone. No sharp curves would be necessary. The maximum grade would be sixty-seven feet per mile, for 4.9 miles.

To cross the divide between Pass and Elk creeks, an earth cut of forty feet at the summit, with an ascending grade rendered by side location eighty-seven feet per mile for 3.8 miles, and a descending grade of 211 feet per mile for 0.9 of a mile, would be requisite. By winding, the last grade would be reduced to 173 feet per mile, for 1.1 miles.

Elk creek would be crossed by a bridge about forty feet in length. The line would then follow the eastern bank of a small tributary for 3.7 miles. From this point an ascending grade, rendered, by location upon the eastern side of the valley, about 186 feet per mile for four miles, would conduct to the summit of Long's hills, where an earth cut of forty feet would be advisable. The descent might be made by winding towards the east for about three miles, with a grade of about 214 feet per mile, but I have no doubt that a little examination would show a much better pass through this line of hills. Having reached the valley at the southern base of the ridge, the railroad would turn towards the west, and after striking the trail of my party, would follow it to the North Umpqua river near Winchester. A bridge about twenty feet in length over a small creek would be necessary on the way. The total increase of distance over that of the travelled road, produced by the above location, would be about 3.3 miles.

The North Umpqua river is about eighty feet in width, and a bridge at least one hundred feet in length would be required. The current is rapid, and the bottom rocky. The stream is unfordable and bordered by low bluffs.

From Winchester the railroad could be located upon the surveyed route to Cañonville, except that it would avoid the high ridge near Roseburg, by following the South Umpqua river. I was informed that this could be done without difficulty, with an increase of distance of about nine miles.

Although no very serious obstacle exists on this route through the Umpqua valley, still some expensive work and heavy grades would be required; and, before a railroad should be actually located, the route by Pass creek to Elk creek, and down that to Umpqua river, and then up the river to the vicinity of Cañonville, should be examined. It is probable that very easy grades might be thus obtained, although the distance would be increased, approximately, forty miles.

Cañonville is situated at the northern base of the Umpqua mountains. This range is a formidable obstacle to the road. The route surveyed through it follows the Umpqua cañon. Near the summit of the divide, elevated 1,963 feet above the sea level, two streams head, one of which flows into Cow creek, and the other into the South Umpqua. The cañon is very narrow, its sides are precipitous and from one to two thousand feet in height, and heavy cutting, or short tunneling, through earth and talcose slate, would be required to obtain practicable curves. In ascending, the grade would be 207 feet per mile for seven miles, and in descending 192 feet per mile for two miles. The latter, however, could be considerably reduced by side location. Numerous short bridges across the stream would be necessary in reaching the summit from the north.

It is probable that a better railroad route through these mountains would be found by following Cow creek cañon. This stream rises south of the range, and, after making a great

bend to the west, flows through it to the South Umpqua. The approximate length of the stream from its mouth to the point where we crossed it, in Rogue River valley, is thirty-five miles. The difference of elevation between these points is about 887 feet. The average ascending grade would, therefore, be only about twenty-five feet per mile. The increase of distance by this route over that by the Umpqua cañon, would be about seventeen miles. According to the best information which I could obtain, Cow creek cañon would require no sharper curves than the Umpqua cañon, and it is a cause of regret, that the want of a proper escort rendered its examination by my party impossible.

Having reached the southern base of the mountains, by the Umpqua cañon road, the divide between Cow and Wolf creeks could be passed, by crossing Cow creek with a bridge about thirty feet in length, two miles before reaching the usual ford, and then gaining the summit by side location, with an ascending grade of about 143 feet per mile, for three miles. The descending grade to Wolf creek could be reduced, by side location, to 187 feet per mile for four miles. I have no doubt that a lower point could be found in this divide a short distance further to the north, and the above grades thus be reduced.

The route examined from Wolf creek to Rogue river was found to be very unfavorable for the construction of a railroad, on account of the Grave Creek hills. These hills separate Grave creek from Wolf creek on the north, and from Jump off Joe creek on the south. They are densely timbered, and, for reasons fully stated in the Itinerary, they could not be thoroughly examined by the party under my command. The hills north of the creek were between 500 and 600 feet in height, and those south between 800 and 900 feet in height, where we crossed them. I believe that a practicable railroad route through both ridges could be found by a little exploration; but, if this should not prove to be the case, the line could follow Wolf creek to Grave creek, and that to Rogue river, and then turn up the latter. Very easy grades could thus be obtained to Evans' ferry, where we crossed the river, with an approximate increase of distance of about thirty miles. According to the best information which could be obtained, no insuperable obstacles would be encountered on the way.*

Should favorable passes through the Grave creek hills be discovered by future examination, a bridge about twenty feet long would be required at Grave creek, and another of about the same length at Jump off Joe creek. From the latter bridge, the line could either follow the trail of my party to the next creek, with the grades indicated upon profile No. 2, sheet No. 2, or, by an increase of distance of about four miles, follow down Jump off Joe creek to the mouth of this tributary, and then take a nearly straight course to Evans' ferry. The grades would be comparatively easy, and the work light, upon the latter route. The little tributary, where we crossed it, was about ten feet in width.

* This is the route indicated on profile No. 2, sheet No. 2, for the proposed railroad line. The approximate altitude of the mouth of Wolf creek, and of the point of striking it, were determined in the following manner. The distance from Evans' ferry to the mouth of Rogue river is about ninety miles by the course of the stream. The altitude at Evans' ferry is 913 feet. Hence, the average descent of the river is about ten feet per mile. This result is confirmed by my observations at Fort Lane. My camp there was about 150 feet above the river, and 1,202 feet above the level of the sea. The water surface near it was, therefore, about 1,052 feet above the sea. Being fourteen miles above Evans' ferry, it should be 1,057 feet, were the estimated descent of ten feet per mile correct. The slight difference of five feet between the observed and computed heights, shows that this estimated descent may be assumed for this river without material error. The mouth of Wolf creek is, approximately, thirty miles below Evans' ferry, and its altitude is, therefore, about 613 feet above the sea. Its distance from Camp 75 A, which is elevated 1,151 feet above the sea, is about twenty-five miles. Hence, the descent of Wolf creek is about twenty-one feet per mile. As the railroad would not come down to the level of the water, before reaching a point about two miles below Camp 75 A, the altitude of this point would be, at the above rate of descent, about 1,109 feet.

At Rogue river, near Evan's ferry, a bridge about 120 feet in length would be necessary. The water flowed with a rapid current over a rocky bed. It was not generally more than three feet in depth near the ferry, but deep holes rendered it dangerous to attempt to ford the stream. The banks were bordered by bluffs from five to fifteen feet in height, and wood and stone for the construction of a bridge were at hand.

From this point a railroad could follow the line of survey to Fort Lane, and thence up the valley of Stewart creek to Camp 78 A, near the foot of the Siskiyou mountains. An average ascending grade of thirty-eight feet per mile, would be required. The labor of construction would be light.

It is considered that a railroad from Vancouver to Camp 78 A, is practicable in the immediate vicinity of the route examined by my party. The construction, for a portion of the line, would be very costly, but the expense would doubtless be greatly reduced by further examination. From Camp 78 A to Fort Reading, however, the obstacles encountered were very great, and although it is highly probable that a practicable line, which can even be approximately located, exists, still no such route was actually surveyed. If, however, a connection could be made between this camp and the route surveyed east of the Cascade Range, some of the most difficult and expensive work upon that line would be avoided, and the settlements in southern Oregon be benefited by the road. The lateness of the season, and the loss of the escort, rendered any survey of the Cascade Range, near the head of Stewart creek, impossible; but there are very good reasons for believing this connection to be eminently practicable. There is a low pass between Mount Pitt and Klamath cañon, by which a good emigrant road now crosses the range and strikes Stewart creek near Camp 78 A. Several persons well acquainted with its character informed me that, according to their judgment, the pass was very favorable for a railroad. Lieutenant Crook, the quartermaster of our expedition, had travelled through it; and his opinion was, that it presented no greater obstacles to the construction of a railroad than many other portions of the route, which actual survey demonstrated to be practicable. This wagon road crosses Lost river at the Natural Bridge, and the connection with the route east of the mountains would be made by the railroad near this place. The approximate distance from Camp 78 A, to the Natural Bridge, is seventy miles. Of this distance about thirty-eight miles were examined and found to be practicable for a railroad, by Lieutenant Williamson, while passing with a detached party round Lower Klamath lake. The altitude of his camp B, near the entrance of the pass, was 3,733 feet. That of Camp 78 A, was 2,195 feet. The distance between these camps is about thirty-two miles, in a direct line; but the windings of the road would probably increase the travelled distance to about forty miles. Hence an approximate average rise of about thirty-eight feet per mile would be necessary, without taking into account that required to pass the dividing ridge.

The first obstacle encountered on my route from Camp 78 A to Fort Reading, was the Siskiyou mountains. The pass surveyed through this chain was very unfavorable for a railroad. From the camp the line would follow a branch of Stewart creek for 3.7 miles, with an ascending grade of 120 feet per mile. A tunnel, about six miles in length, would then be necessary. The surface rock is a conglomerate sandstone. An ascending grade of about 137 feet per mile would be required in the tunnel, which would pass 1,461 feet below the summit of the mountain. A modification of this grade, so as to form a summit near the middle of the tunnel, might be advisable, in order to insure drainage during the excavation. For 1.1 miles from the northern, and for 1.3 miles from the southern entrance, shafts of less than 600 feet in depth could be sunk.

For 3.6 miles between these points, every shaft would necessarily be deeper than this. From the southern entrance there would be a descent of 1,268 feet to Klamath river. By the route travelled two small ridges were crossed in the descent. The grades given on profile No. 2, sheet No. 2, could be obtained by side location near the line of survey; but it is probable that the small creek which was struck soon after leaving the summit, might be followed to Cottonwood creek, and that to Klamath river. The heavy grades would be thus avoided, and the approximate descending grade, from the southern entrance of the tunnel to the river, reduced to about eighty feet per mile, for about sixteen miles.

There is every probability that by further examination a pass much better than this might be discovered through the range. In fact, I was informed that one was already known, further toward the east, which was much more favorable for a railroad. The loss of the escort rendered its examination impossible.

At Klamath river a bridge about 150 feet in length would be requisite. The banks were from ten to twenty feet in height. The current flowed very rapidly, over large rocks. The stream was not generally more than two or three feet in depth, but there seemed to be many deep holes.

From Dewitt's ferry over Klamath river to Yreka, a distance of 17.5 miles, a railroad could be located with an average ascending grade of twenty-two feet per mile. Part of the route passes over a slightly undulating country, but neither heavy grades, nor deep cutting, would be required.

At Yreka the proposed railroad line diverges from my travelled route. The loss of the escort, and of the quartermaster and commissary of the expedition, who was detained at Fort Jones by the commanding officer of that post, rendered it necessary to abandon the idea of surveying the Sacramento river route to Fort Reading, which promised to be favorable for the construction of a railroad, and compelled me to pass over the Trinity trail, which proved, as had been anticipated, utterly impracticable for this purpose.

Before considering the proposed railroad line, the obstacles upon the Trinity trail will be briefly described. By reference to profile No. 1, sheet No. 2, it will be seen that three prominent ridges were crossed upon the route, besides some hills near Shasta. The first, Little Scott's mountains, can probably be turned by following down Klamath river to the mouth of Scott's river, and then passing up the valley of that stream. The approximate increase of distance from Dewitt's ferry to Fort Jones, over that of the travelled road, would be twenty miles. Heavy rock cutting through lateral spurs would undoubtedly be necessary in many places, but the construction in Scott's valley would be easy. The second ridge, Scott's mountains, could only be passed by a tunnel, about ten miles long, excavated through granitic rock. The tunnel would pass about 2,000 feet below the summit. In Trinity valley much heavy stone cutting and numerous bridges would render the construction very expensive. The third ridge, Trinity mountains, would require a tunnel through granitic rock about four miles in length, passing 2,000 feet below the summit. The hills near Shasta could probably be turned by following Clear creek to the Sacramento river; but the cost of the two tunnels in the mining region, where the price of labor is very high, would be too enormous to estimate.

Another route from Yreka to Fort Reading, which is unquestionably practicable for a railroad, is to follow an easterly course until a junction is effected with our line of survey east of the Cascade Range, and then to follow that route to the Fort. In 1852, Lieutenant Williamson explored the country which the line of connection would traverse, and found it a nearly level

plateau, which would present no serious obstacle to the construction of the road. This route would be very circuitous, however, making the distance from Yreka to the Fort between 250 and 300 miles, while, in a right line, it is only about 90 miles.

It is believed that this detour could be avoided by striking the head-waters of the Sacramento river west of Shasta Butte, and then following the course of the stream to Fort Reading. I was prevented, for the reasons above stated, from surveying this line; but a party of gentlemen from Shasta recently examined it with reference to the construction of a wagon road, and made a favorable report,* estimating the expense at \$50,000. I had a personal interview with one of these gentlemen. He stated, that, although some sharp curves and deep cuts would be necessary, he had no doubt that a railroad could be constructed upon the route at a reasonable expense.

* It has been deemed advisable to subjoin this report in full as it appeared in the Yreka Union of November 3, 1855.

Wagon road from Yreka to Shasta.

YREKA, October 29, 1855.

We, the undersigned, who left Shasta on the 25th instant for the purpose of examining the route for a wagon road to Yreka, via the Sacramento river, arrived at this place on Sunday morning last.

The entire length of the road will probably reach one hundred and ten miles. The general course is directly north, and no deflections from a straight line occur, except in those places where the short bends of the river must be followed. All the difficulties to be overcome, and work necessary to render the entire route practicable for heavily loaded wagons, lies between Spring creek and the Soda spring, a distance of about sixty-nine miles. More or less grading, bridging, etc., will be necessary upon about fifty miles of this distance. The remaining fourteen is taken up by level plateaus from a half to five miles in length, many of them being fine arable land, with a deep, rich soil.

The most important obstacles to be overcome are two long ascents. The first is encountered immediately after crossing Sugar Loaf creek, twenty-five miles from Shasta, and the other at Potato hill, nine miles further on. Both these can be passed without much difficulty by taking a circuitous course around the hill, and attaining the summit by a succession of easy gradients, alternating with occasional short benches, made level to relieve the ascent. With the exception of these two hills, and three or four minor ones, the whole road can be made comparatively level.

It is our opinion that about thirty miles will require heavy excavation. This occurs at various points along the entire distance from Spring creek to the Soda spring. The points we have referred to are where the road is thrown upon those portions of the river bank which are steep. Those places are generally from half a mile to a mile in length, and between them we have level flats or slightly undulating ridges, where but little work would be necessary, except to bridge the creeks which are generally met with at those points.

Fine timber grows near at hand for all the wood work which will be needed, and two saw mills are already constructed, the one at Spring creek, and the other at Squaw creek. Between Pistol and Sugar Loaf creeks more or less blasting will be required upon two miles of the route, none of which, however, is of a serious character.

Beyond the Soda springs all obstacles vanish. All that will be required is to clear the way through a level, timbered country as far as the huckleberry patch at the head of Shasta valley; from thence into Yreka an excellent wagon road already exists. More work will be necessary to construct a wagon road by this route than was at first anticipated by us; but on the other hand we are satisfied that it is the most direct course, and that when the road is once built, it will be the easiest and most substantial mountain route in California. Following, as it does, the course of a river until it arrives at its source, it then enters a level plain, and no dividing ridges are to be crossed separating stream from stream, as is the case with nearly all the wagon roads which have been constructed in like cases.

It will probably be expected that we should make some rough estimate of the cost of this route. It is with extreme reluctance that we enter upon any such calculation, as we are aware, that in making our estimate of the distance, we are liable, in many instances, to be grossly deceived; for in many places where the trail we were travelling upon passes over the hills, the road would continue level along the bank of the river.

We are of opinion, however, that our errors in this respect are on the right side, and that the route of the road will prove when marked out and measured, to be considerably shorter than the distances given by us. We believe that the sum of fifty thousand dollars, or near that amount, will be required to perform the grading and erect the numerous bridges necessary to construct a good, easily travelled, and substantial wagon road, up the Sacramento river, from Shasta to Yreka. A recapitulation of the numerous creeks, the different points to be encountered, and the various distances, we consider unnecessary to be here stated, as those items would render our report too lengthy, and, from our limited means of observation, would not possess a sufficient degree of exactness.

It is our candid opinion that this undertaking cannot be at once accomplished by private contributions. An attempt to do so would, we fear, result in disappointment, and perhaps a failure of the whole enterprise. We would, therefore, suggest

It is proper to state why the altitude of the divide between Sacramento and Shasta rivers has been assumed at 3,500 feet, on profile No. 2, sheet No. 2, upon which the Sacramento river route is indicated for the proposed railroad line. This is only an approximation to the truth; but I believe it worthy of some reliance for the following reasons. It will be noticed in the report upon the wagon road from Yreka to Shasta, contained in the last note, that this passage occurs: "Following, as it (the proposed wagon road) does, the course of a river (the Sacramento) until it arrives at its source, it then enters a level plain, and no dividing ridges are to be crossed separating stream from stream, as is the case with nearly all the wagon roads which have been constructed in like cases." On profile No. 1, sheet No. 2, representing the surveyed line, it will be seen that Shasta Butte rises from a natural eminence, which extends many miles both north and south of the mountain. The greatest altitude upon this pedestal of the Butte, where we crossed it, is, without taking into account isolated ridges, 3,457 feet. These two facts have led me to assume an altitude of 3,500 feet for the divide. This altitude gives an average descent of more than forty feet per mile to Shasta river, and to the Sacramento river above Johnson's ferry; descents, which, in my opinion, are very much greater than the appearances of the streams justify. Any less altitude would, of course, render the route more favorable to the construction of a railroad.

As soon as the open portion of the Sacramento valley should be gained, there would be no further difficulty in reaching Fort Reading with easy grades. The total distance from Yreka to the Fort, by this route, is 120 miles.

that a stock company be formed, and a charter applied for at the next session of the legislature. This plan will insure the early completion of an enterprise which will open an exhaustless mining region, now nearly untouched, and place the town of Yreka, and the whole northern portion of the State, now so difficult of access even by pack trains, within five or six days' travel, by loaded wagons, of the different depots in Sacramento valley.

E. C. GILLETTE.
A. SKILLMAN.
W. W. TRACY.
JOHN J. TOMLINSON.
M. A. MIX.
R. A. McCABE.
M. MITCHELL.
J. TYSON.

CHAPTER III.

NARRATIVE AND ITINERARY.—ROUTE OF THE MAIN COMMAND.

PREPARATIONS.—ORGANIZATION AND OUTFIT OF PARTY.—SUISUN VALLEY.—PUTOS CREEK.—CACBE CREEK.—SACRAMENTO RIVER.—FEATHER RIVER.—MARYSVILLE.—MIRAGE.—DIGGER INDIANS.—THEIR HUTS.—THEIR MODE OF GAMBLING.—GRIZZLY BEARS.—TWO ROUTES EXAMINED FROM ANTELOPE CREEK TO FORT READING.—FORT READING.—OFFICERS THERE.—THE ESCORT.—BAROMETER LEFT WITH DR. HAMMOND.—GUIDE EMPLOYED.—START.—DISAGREEABLE CAMP.—MC CUMBER'S FLAT.—NORRIS'S PASS.—VIEW FROM SUMMIT.—LOST CREEK.—COLD.—INDIAN SIGNS.—CANOE CREEK.—PUMICE-STONE.—PEDREGAL OF TRAP ROCK.—ACCIDENT TO CHRONOMETERS.—DIFFICULT TRAVELLING.—PRECIPICE.—PRAIRIES WITH SPRINGS.—PIT RIVER INDIANS.—THEIR HABITS.—THEIR BOWS AND ARROWS.—INDIAN TRAIL.—LARGE RIVER GUSHING FROM THE ROCKS.—EXPLORATION BY LIEUT. WILLIAMSON.—PIT RIVER.—LIEUT. SHERIDAN.—EXPLORATION OF LOWER CAÑON OF PIT RIVER.—LIEUT. HOOD'S RETURN.—STONEMAN'S RIDGE.—ROUTE BETWEEN THE CAÑONS.—FIRE IN CAMP.—UPPER CAÑON OF PIT RIVER.—CART BROKEN.—INDIANS.—THEIR MODE OF KINDLING A FIRE.—THEIR LOVE OF TOBACCO.—THEIR ORNAMENTS.—LIEUT. WILLIAMSON'S NOTES ON THE CAÑON.—GRASS VALLEY.—PITS DUG BY INDIANS.—EXPLORATION IN ADVANCE BY LIEUT. WILLIAMSON.—SPRING BRANCH.—BAKED ANTELOPE'S HEAD.—SAGE PLAIN.—WRIGHT LAKE.—RHETT LAKE.—EMIGRANT ROAD.—LOST RIVER.—NO FUEL.—PARTY FROM YREKA.—DIVISION OF THE PARTY.—NATURAL BRIDGE.—RATTLESNAKE UNDER A BLANKET.—UPPER KLAMATH LAKE.—INDIAN SIGNS.—SNAKES.—FIRE IN CAMP.—ARRIVAL OF LIEUT. WILLIAMSON.—ROUTE NEAR EASTERN SHORE OF LAKE.—BOLD EAGLES.—ACCIDENT.—KLAMATH RIVER.—CAÑON.—FOG.—KLAMATH J. LASH.—INDIANS.—THEIR RANCHERIAS.—THEIR CANOES.—THEIR GRAVES.—GRAVE OF A CHIEF.—PILES OF STONES.—INTERCOURSE WITH THE INDIANS.—THEIR HORSES.—PARTIAL VOCABULARY OF THEIR LANGUAGE.—CROSSING OF KLAMATH RIVER.—DIVIDE BETWEEN KLAMATH MARSH AND DES CHUTES RIVER.—WATER HOLES.—PUMICE.—DES CHUTES RIVER.—TWO TRAILS.—TROUT.—OLD WAGON TRAIL.—DIFFICULTY IN TAKING ASTRONOMICAL OBSERVATIONS.—SICKNESS.—DIVISION OF PARTY.—ICE IN CAMP.—INGENIOUS METHOD OF REPAIRING CHRONOMETER.—GOLD SEEKERS FROM UMPQUA VALLEY.—ORDERS FROM LIEUT. WILLIAMSON.—BRANCH OF DES CHUTES RIVER.—RAFTING OF STREAM.—ENTRANCE OF GREAT CAÑON.—RAPID.—JUNCTION WITH LIEUT. WILLIAMSON'S PARTY.—RAIN.—SNOW PEAKS IN SIGHT.—WHY-CHUS CREEK.—CAMP NEAR "FORKS OF THE INDIAN TRAIL."—BERRIES.—DIVISION OF THE PARTY.—SKETCH OF SUBSEQUENT OPERATIONS.

ON May 5th, 1855, Lieut. Williamson, with the civilian assistants and myself, sailed from New York, and on May 30 arrived at San Francisco. Here he organized the surveying party. On July 9, 1855, the command was in depot camp, near Benicia, and ready to commence field work on the following day.

The party consisted of Lieut. R. S. Williamson, Topographical Engineers, in charge of the expedition, with myself for his principal assistant; Dr. J. S. Newberry, geologist and botanist, Mr. H. C. Fillebrown, assistant engineer; Dr. E. Sterling, physician and naturalist; Mr. C. D. Anderson, computer; and Mr. John Young, draughtsman. There were also eighteen men, under the immediate supervision of Mr. Charles Coleman, the pack master.

As much of the survey was to be made in a mountainous, unexplored region, Lieut. Williamson decided to transport all the supplies by a pack train. The only vehicle was a light two-wheeled cart, designed solely to carry the instruments. These consisted of two Gambey sextants, two artificial horizons, four box chronometers, three prismatic compasses, one surveyor's chain and pins, one odometer, four Green's cistern barometers, with a case of extra unfilled tubes, four thermometers, two reconnoitring glasses, one aneroid barometer, and several smaller instruments.

July 10.—We left camp about noon. The road, at first, led over low rolling hills to the marshy edge of Suisun bay. After following this for a short distance, it passed over a nearly level country, to a small creek with slightly brackish water. It then crossed a level plain, bordered by low hills and dotted with a few oaks, to Suisun creek, where we encamped. Much of the soil near the road to-day was rich and under cultivation.

July 11.—The road was at first slightly hilly, and bordered by a few scattered oaks. It then crossed a level plain, bare of trees, where the heat was very oppressive. We found a little lake on this plain, and the dry beds of two small streams, which were evidently tributaries in the rainy season. Towards the end of the day's march, the country again became undulating. We encamped on a small creek, near a collection of two or three houses called Vacaville.

July 12.—To-day, we travelled among the low foot hills of the Coast Range to Putos creek, where there were several fine oak, peach, and fig trees, and a vineyard. The hills could be avoided by keeping further towards the east. Lieut. Williamson made the following note upon Putos creek, in his journal: "Putos creek, at the most favorable point, requires a bridge 130 feet in length. The bed of the stream is now 20 feet below the banks, and the water less than a foot deep. In the winter and spring, the banks are nearly reached by the water. The stream, I am informed, was named after a tribe of Indians which lived upon its banks, and which were known to the Spaniards as the Putos Indians; the word 'putos', being masculine, means a lazy, worthless vagabond. Hence the creek was called Rio de los Putos. It is, however, generally called Puta creek, and sometimes Pewter creek."

The road next crossed a dry, dusty plain, several miles in width, where every breath of air felt like the blast of a furnace, so intense was the heat. We then entered a fine oak forest, which skirted the banks of Cache creek. We encamped at the lower ford of this creek, after having crossed at the upper. The following extract is from Lieut. Williamson's journal.

"This stream has, in many places, a bottom as much as a half mile wide. The width of the stream itself, at the narrowest part I saw near the upper crossing, was, I should think, about 300 yards. At the lower crossing, it was much narrower, being only about 100 yards wide, with banks 30 feet high. I am told that in times of freshet it rises so much as to overflow these banks."

July 13.—Early this morning, we reached the Sacramento river at Knight's rancho, and, finding that the most direct road to Marysville was impassable on account of mire, followed down the river to Frémont. Here we crossed by a ferry. The water was low, the river being only about 250 yards in width. At season of high water it is at least 100 yards wider, and during freshets it sometimes overflows its banks for miles. It is bordered by a dense growth of willows, sycamores and oaks. We followed up Feather river for about 8.5 miles, and encamped near Nicholas. The road to-day was level, and often led through noble forests of oak. There was little or no underbrush, and the country resembled a grand old park in appearance. Many large squirrels were seen among the trees.

July 14.—For a few miles this morning, the road continued to be bordered by the noble oak forest. The extreme shortness of their trunks gave the trees the strange appearance of having been pressed down into the ground. On leaving the forest, we travelled over a dry, dusty plain, which continued to Marysville, a fine little city, containing several brick stores and houses, and presenting a very thriving appearance. It is situated near the junction of the Yuba and Feather rivers. We encamped opposite it, on the former stream, which was turbid from the gold washing carried on near its sources. The sediment deposited by it is having a marked effect upon the navigation of Feather river.

July 15.—To-day we forded the Yuba river, and after passing through Marysville crossed Feather river by a good wooden bridge. The first stream was about 200, and the second 250 feet in width, and both were bordered by low bluffs. Lieutenant Williamson decided to make a

short march to-day, as it was necessary to repair the pack saddles. We accordingly travelled only 5.8 miles, through a level, dusty country, and encamped on Feather river.

July 16.—After travelling over a very dusty, level road bordered by scattered oaks, we encamped at Hamilton. The heat was very oppressive during the day.

July 17.—The road to-day left Feather river, and struck across a dry, dusty plain, to Niel's rancho, on Butte creek. The phenomenon of mirage was very distinctly seen during the early part of the march. We crossed Butte creek and Little Butte creek, about three miles beyond it, and encamped on Chico creek. The country was flat and uninteresting. Near camp was a rancheria of Digger Indians. Their huts were partly excavated in the ground, and roofed over with sticks plastered with mud. When we visited them, at about sunset, the women were sitting on top of their houses, engaged in shelling out grain which they had gleaned from the neighboring fields. The men, nearly naked, were congregated in a large hut, gambling. A few burning sticks in the centre of the group threw a flickering light over the scene. The game was played by four men, who were seated in pairs, on opposite sides of the fire, while the background was filled up with eager spectators. Before each party was a pile of straw. One couple continually twisted up, and threw into the air, wisps of this straw, managing at the same time to conceal in it two pieces of white wood or bone. The other couple anxiously watched their movements, keeping up a monotonous, guttural cry. Whenever they thought they had detected the locality of the sticks, they clapped their hands violently, and their rivals immediately shook open the suspected wisp. If the sticks were there, the successful guessers received them, and began in their turn to throw them up; if not, the first couple continued. The excitement occasioned by this simple game was intense. The perspiration poured in streams down the naked bodies of the players, and their eyes glared in the dim fire-light like those of demons. Their voices were so hoarse as to be hardly articulate, and yet they kept on, without a moment's cessation. They might well be excited, for, as I was informed, they stake everything, even their women and children, on the result of the game.

July 18.—To-day the road lay mostly over dusty plains, destitute of timber. Dry gullies, which in the rainy season are undoubtedly the beds of streams of considerable size, were numerous. We encamped on Deer creek. During the evening quite an excitement was created by the report that a grizzly bear was in the bushes near us; but the monster proved to be only a burnt log. Grizzly bears are sometimes found in this part of the valley.

July 19.—We travelled over a slightly undulating country to Antelope creek, where we encamped. The road crossed several places where there were sudden descents, of about twenty feet, from a plateau to a lower level; and, in distances varying from a few yards to half a mile, corresponding ascents again. These places did not resemble the beds of creeks. There was but little timber near the road during most of the day's march.

July 20.—This morning Lieut. Williamson gave me instructions to cross the Sacramento river, at Red Bluffs, with the instrument cart, and follow the ordinary route to Fort Reading; while he proceeded with the main party to examine the eastern bank. This I did, without any incident worthy of note. The country, which was slightly undulating, and occasionally timbered, differed in no important particulars from the portion of the valley traversed during the last few days by the main party. The following description of Lieut. Williamson's route to the Fort is compiled from his note book.

"After following a road over the hills, for about ten miles, this morning, we discovered that it led to a pinery among the mountains. We, therefore, turned nearly at right angles to our

former course, and struck across the hills to Beaver creek, which we found flowing in a small cañon. We then crossed a rocky plain to Liver creek, where we encamped. The hills may be avoided by keeping nearer the bank of the Sacramento.

"July 21.—As far as Battle creek we found the road pretty rough. At first it crossed a ridge, which might be avoided, with some rock cutting, by passing around the bluff. The rest of the road to the Fort was good, a few short, steep slopes excepted."

Fort Reading is situated on the northern bank of Cow creek, a little stream which discharges itself into the Sacramento, about a mile and a half below the post. There are dry, elevated plains northwest, and a steep bluff conducting to a higher plateau, east of the Fort. The buildings are mostly made of adobes; but some are of wood. The locality is unhealthy in the summer, on account of the prevalence of fever and ague.

We were courteously received and hospitably entertained by Major F. O. Wyse, 3d artillery, and the other officers stationed at the post. The escort here joined us. It consisted of Lieut. H. G. Gibson, 3d artillery; Lieut. George Crook, 4th infantry, commissary and quartermaster of the expedition; Lieut. J. B. Hood, 2d cavalry; and 100 men, twenty being dragoons, and the remainder artillery and infantry soldiers. Mr. J. Daniels was quartermaster's clerk, and Mr. J. B. Vinton pack master of the escort.

Various causes of delay prevented Lieut. Williamson from continuing the survey until the twenty-eighth of July. Dr. J. F. Hammond, United States army, the surgeon of the Fort, very kindly volunteered to have a series of barometric observations taken at the post, during the continuance of the field work. Lieut. Williamson accordingly left one of the barometers in his charge. His observations proved of very great value in the subsequent computation of altitudes upon the route, as is fully explained in the chapter of this report devoted to that subject.

At the recommendation of Major Reading, Lieut. Williamson employed as guide and scout an old hunter, named Bartee, but usually known as "Old Red." He proved a valuable addition to the party.

July 28.—To-day we left Fort Reading, and began our journey towards the wild region east of the western chain of the Sierra Nevada. Lieut. Crook, with the foot soldiers and the escort train, had left Fort Reading two days before our departure, and encamped at McCumber's Flat, distant 30 miles from the post. Lieut. Williamson, being detained by necessary business, sent forward his train this morning, and started about noon to follow it with his assistants, accompanied for a short distance by Dr. Hammond. We crossed Cow creek at a good ford, where the stream was about 50 feet in width, and then abruptly ascended to a level plateau, elevated about 200 feet above the Fort. We travelled 3.5 miles over this plain to the crossing of Bear creek, a branch about 30 feet in width; and then began a gradual ascent. The road soon entered a thick pine and oak forest, varied by occasional clumps of manzanita bushes. Grizzly bears are often found in this vicinity. Our train had taken a wrong road, and we were compelled, in consequence, to encamp without blankets or cooking utensils, near the small rancho of Mr. Asbury. A rather cold and uncomfortable night was spent by most of us.

July 29.—To-day we started early, and continued our course through a thick pine and fir forest, many trees of which bore long, graceful bunches of black and light colored mosses, with an occasional bough of mistletoe. We crossed two small streams, the first, Ash creek, about ten feet, and the second, Mill creek, about twenty feet in width. The water of the latter was very cold, its temperature being 47° Fahrenheit, while that of the air was 79° Fahrenheit.

At both creeks saw mills were in operation. The ascent to-day was much steeper than that of yesterday. We reached Lieutenant Crook's camp at McCumber's Flat, on Battle creek, at about 1 p. m., and our missing train arrived in the course of the afternoon. We had gained an elevation of about 3,600 feet above Fort Reading, and the clear, cool air of the mountains was delightful, when compared with the burning, sickly miasma which we had left behind. The seeds of intermittent fever, however, implanted while passing through the Sacramento valley, remained, and a large majority of the party suffered from this disease before the end of the survey.

McCumber's Flat is a small opening, thickly carpeted with grass, and surrounded by a dense pine and fir forest. Battle creek, after passing through it, disappears among the trees, and with a sullen roar struggles furiously down its rocky bed. A more pleasant camping place could hardly be desired.

July 30.—To-day, we crossed the western chain of the Sierra Nevada, by Noble's Pass. The road, which was very steep, rocky, and bordered by pine timber, followed up a branch of Battle creek. In some places it was difficult to drag even the light instrument cart up the precipitous ridges. After leaving the creek, a very steep rise conducted to a long, gently ascending slope, bare of trees, but covered with a dense growth of manzanita bushes. This slope led to the divide, which was perceptible, although by no means steep. Its elevation above the sea was 6,260 feet. A fine view was obtained from a point near the road. Lassen's Butte with its snowy crest, rose proudly above the surrounding mountains on the south. Far distant to the westward was a long line of peaks, belonging to the Coast Range, while at our feet lay the Sacramento valley. But we turned gladly from its parched plains to scan the rough country towards the east, which we were next to traverse. The course of Pit river, as it came from the dim distance, and wound out of sight among the mountains on the north, could be indistinctly traced; while dark timbered ridges, with occasional plains, filled up the rest of the picture.

The descent from the summit was at first gentle, but soon became precipitous. The Indians had recently set fire to the woods, and the smoke, mingling with the clouds of dust raised by our animals, was stifling. Near the foot of the ridge, we struck a small stream about fifteen feet in width, called Lost creek. After leaving the road and following down this creek about half a mile, we encamped with good grass and water. The forest was more open on the eastern than on the western slope of the mountains, and it was now almost entirely composed of pine. A deer had been killed on the march, and we had our first venison to-night.

July 31.—This morning, at half past five o'clock, the thermometer indicated 40° Fahrenheit, a great change in temperature from the Sacramento valley, where it had generally stood at about 65° Fahrenheit at this hour. We retraced our steps to the emigrant road, and after bidding farewell to Dr. Hammond, who returned to Fort Reading, followed it through an open and nearly level valley to the next stream, which was about twenty feet in width and called Hat creek. Both this and Lost creek are branches of Canoe creek. After crossing the stream, we left the road, and followed down the valley, without any trail. Light smoke, rising from the summits of the neighboring hills, informed us that our advance was discovered by the watchful savages, although we had seen none of them as yet. The route was good at first, although somewhat obstructed by manzanita bushes, which delayed the little cart. As we advanced, however, we had to pass several rocky ledges. The creek at length divided into two channels, enclosing a small island. This we crossed, and following the western side of the stream soon came to where it cañoned through a ledge, nearly vertical on one side, and gently sloping on

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VIEW OF THE MOUNTAIN CAMP

the other. Crossing this with difficulty, we again struck the stream, and re-crossed it over another island to the eastern bank. The soil became light, like ashes, and our animals sank over the fetlock at every step. The hills soon closed in upon the creek, and we encamped with good water and grass. Lieutenant Williamson sent the guide forward to examine the route for a short distance in advance. On his return he reported it very rocky and destitute of grass. A barometer was broken to-day by the jolting of the cart.

August 1.—This morning we entered a rocky pedregal of scoriaceous trap, which taxed our patience to the utmost. It was difficult to advance with the mules, but far more so with the cart. We were forced to make long halts before a way could be found, and then to almost carry the vehicle along by hand. Once it overturned, and the shock rendered the chronometers useless for the determination of longitude for the rest of the survey. Instead of improving, the road became worse; and, at length, we turned towards the timbered hills which bounded it on the east, and travelled among them for a short distance with more ease. Before long, however, we found ourselves on the summit of a precipice of trap rock, at least one hundred feet in height, which conducted to the lava field again. The cart was let down by hand; and we toiled on, near the ledge which continued to bound the valley, until we suddenly came to a beautiful, grassy spot, intersected by numerous brooks. Here we encamped, after a most laborious march, having advanced only about 4.5 miles on our journey. A branch of the stream gushed from the face of the precipice near our camp, and, after falling about twenty or thirty feet vertically, united with another which flowed at the base of the ledge. The following note upon these springs I extract from Lieut. Williamson's journal.

"A portion of the water of the brooks gushed from a spring in the mountain side. It is highly probable that the main part comes from a cañon in the hills to the northeast, but of this we have no positive proof. About a quarter of a mile below camp, all the streams, after uniting in one, disappear entirely, flowing into chasms in the scoriaceous trap. Whether it re-appears, or not, is not known. The united stream is about twenty feet wide, and belly-deep to the mules."

While examining the vicinity of camp with one of the party, I came suddenly upon an Indian, evidently reconnoitring. He was nearly naked, and armed with bow and arrows. With considerable difficulty we prevailed upon him to enter camp. After throwing him into paroxysms of delight by the sight of his ugly countenance in a small mirror, we sent him on his way rejoicing, appareled in a white shirt, and gnawing a huge piece of salt pork.

August 2.—This morning our visitor returned with about twenty of his nearly naked friends, all of whom gave us to understand that they were enduring agonies of hunger. After giving them food, we left the miserable wretches collecting the offal which remained near the cook's fire. The Pit river Indians are very treacherous and bloody in their dispositions and disgusting in their habits. They are armed with bows and arrows, which they make with great skill. The bows are sticks of soft wood, about three feet in length, backed with deer sinew. The bow string also is of sinew. The arrows are made in three parts. The head is generally of obsidian, which abounds in portions of the valley. It is carefully shaped into the usual barbed form, and lashed by deer sinew to one end of a small stick of hard wood about ten inches long. The other end of the stick is inserted into the extremity of a reed and also lashed with sinew. The reed is tipped with feathers, attached by the same kind of fastening. This weapon inflicts a dangerous injury; as the blood immediately softens the sinew, and, on attempting to extract the arrow, the reed separates from the hard wood stick, and that from the arrow head,

which thus remains at the bottom of the wound. It is said that these savages sometimes poison their arrows by exposing a piece of liver to the repeated bites of a rattlesnake, and, after burying it for a short time, smearing the point with the half decomposed mass.

For about five miles to-day, the pedregal continued to be as rough as it was yesterday, and we could advance only with great difficulty. At length, however, we entered a pine forest, and soon after struck an Indian trail, which rendered travelling very much easier. It conducted us to the bank of Canoe creek, which we found flowing through a fine, grassy meadow. Again entering the forest, and continuing our course for a few miles further, we discovered a second fine valley, carpeted with grass and clover. Near the northern side of it flowed a tributary of Canoe creek, at least five times the size of the main stream. We encamped near the junction of these creeks, with an abundant supply of wood, water, and grass.

August 3.—Some little doubt had arisen whether the large tributary on which we were encamped was not Pit river, and Lieut. Williamson determined to leave the main party in camp to-day, and go himself, with the dragoons, to explore. He returned about noon, having followed down Canoe creek to where it discharged into Pit river. It flowed between precipitous banks, with many cascades and rapids. At its mouth it was eighty or ninety feet in width. It received no important tributary below our camp, except a branch from Lake Freaner, which flowed into it over a trap dike about fifteen feet in height.

In the afternoon, Lieut. Williamson sent one of the party to follow up the large tributary of Canoe creek. On his return, the man reported that, about two miles above camp, the water gushed furiously from some fifteen crevices in the rocks, thus forming brooks, which united and formed the stream. He walked entirely round its sources, and returned dry shod on the bank opposite the one on which he started.

August 4.—This morning the party separated. Lieut. Williamson started with the dragoons, to explore the lower cañon of Pit river, giving me directions to advance, with the main party, to a point on the river near the mouth of Canoe creek. After leaving camp, we soon found ourselves among thick pine timber and underbrush, which greatly delayed the cart, and rendered it necessary to carry most of the instruments by hand. In some places the trail followed along the side of steep hills, and several men were constantly employed in preventing the vehicle from overturning. At length, in attempting to run over a manzanita bush in one of these places, it turned completely over; so that the mule lay on his back, struggling violently in the thick underbrush. After crossing one smaller branch, we finally succeeded in reaching a fine, grassy meadow on the bank of Pit river, about two miles above the mouth of Canoe creek. Here we encamped.

Lieut. P. H. Sheridan, 4th infantry, overtook the party to-day, with orders to relieve Lieut. Hood, who was instructed to return to the eastern States and join his regiment without delay.

The following extract from Lieut. Williamson's journal shows the result of his exploration to-day.

"We followed nearly the same trail as yesterday for about five miles, and then took a trail running east, which led to Stoneman's ridge. I went to the highest point, and obtained bearings to Mount Shasta, Lassen's Butte, and other peaks. I then ordered Bartee to follow the ridge towards the south until he found a low depression, and then to endeavor to find a good route from it to the river near Canoe creek. This he did. I next went to the entrance of the cañon. We found it impossible to go through it on foot, on account of the precipitous

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sides, which came down abruptly into the water. The north side was black rock, inclined about 45° . The south side was infusorial earth, inclined from the horizon 60° or more. Not being able to follow the summit of the precipice, I returned down the river to camp, near the mouth of Canoe creek."

August 5.—Lieut. Hood started this morning with a small escort, on his return to Fort Reading, much to the regret of the whole party. Lieut. Williamson, with the dragoons, went to follow the river bluff, directing me to take the trail through the pass found yesterday by Bartee. The trail led over several small, rocky hills, heavily timbered with pine. After passing along the western foot of Stoneman's ridge for nearly two miles, we crossed it at a low point, and followed down a gentle slope to the river. The soil was mostly light volcanic ashes, but the trail was occasionally rocky. After riding a short distance near the stream, which was deep and sluggish, we passed the spot where Fall river, after breaking in cascades and rapids over a bluff about 30 feet in height, plunges into Pit river. About half a mile further on, we found Lieut. Williamson encamped near a small brook, a tributary of Pit river. Its water was much colder than that of the river, which had a marshy taste. Wood and grass abounded in the vicinity. Lieut. Williamson had succeeded in following the river bluff. Where the stream emerged from the mountains, and for about a mile above, he found the banks about 150 feet in height, and very precipitous. The cañon was so narrow at its mouth that he could not enter it on foot.

After reaching camp, I re-filled two barometers which had been broken. During the night a mule was stolen by the Indians.

August 6.—This morning, to avoid a bend, Lieut. Williamson left the river and struck across towards the upper cañon. At first, the trail passed through pine timber, but it soon entered a nearly level prairie, in some places rocky, and in others dusty. There were numerous gopher holes in it, which were dug so near the surface that our animals often broke through into them. After reaching the river again, the trail became quite rocky, and we were compelled to cross numerous sloughs, as well as the main stream twice. At length we encamped near the entrance of the upper cañon. A fire soon broke out among the dry grass and bushes, which was extinguished, with difficulty, by the united exertions of the whole command. Another barometer was broken and re-filled to-day. At night the Indians stole a mule, but it was traced, found tied in one of their rancherias, and recovered by our packers.

August 7.—To-day Lieut. Williamson followed along the northern edge of the cañon, directing me to take the route among the hills with the main party. On leaving camp, we crossed the river at a shallow but very rocky ford, and immediately climbed the river bluff, which was more than 100 feet in height, and so steep that it required twenty men to pull up the instrument cart. The chief obstacle to travel to-day was a vast amount of trap rock, which covered the ground in many places. In others, the heat of the sun had baked the earth, and made it crack in a manner which rendered travelling laborious. We saw but little timber on the road; and the hills were generally low, and not very steep. In passing over the rocks, one spring and the axle of the cart were broken. I succeeded in transporting it to camp, but there found it to be irreparably injured. The body was abandoned, but the axle was mended sufficiently to hold the wheels together, in order to continue the use of the odometer.

Several Indians came into camp in the afternoon, and I saw one of them kindle a fire by rubbing two pieces of wood together. A block of cedar, about six inches square and one inch thick, perforated with a small hole, formed the lower piece. One Indian held this firmly on a horizontal rock, after having placed a little tinder under the hole. A second took a round

stick, apparently of elder, about six inches long and a quarter of an inch in diameter, and, inserting one end in the hole, rolled it very rapidly between the palms of his hands. In a few moments sparks of fire fell down upon the tinder and ignited it. These savages have a fondness for smoking tobacco, which I have never seen equalled. They inhale the smoke, and, after retaining it as long as possible, force it through their nostrils in an ecstasy of pleasure. They mark their faces with black, as a sign of mourning, and with red, for ornament; but I have never seen both colors used at once. Many of them perforate the nose, and insert a straight piece of bone about an inch and a half in length.

Our camp to-night was on the river bank near the eastern entrance of the cañon, where we found an abundant supply of excellent grass. I extract the following remarks upon the cañon, from Lieut. Williamson's note book.

"The river itself was shallow throughout the whole cañon, and always had a space between the water and bluff wide enough for a wagon road. No falls were noticed, and I saw nearly the whole of the cañon. The bluffs were from 100 to 700 or 800 feet in height, and of basaltic trap. The slope was generally of the debris from the rock, but often vertical columns of the basalt were seen. In one place I noticed veins of a red material, the color of cinnabar."

August 8.—After fording the river, which was about forty feet in width, we continued our course through a level, grassy valley, bare of trees. Several grouse, duck and curlew were shot on the march. We passed many pits about six feet deep and lightly covered with twigs and grass. The river derives its name from these pits, which are dug by the Indians to entrap game. On this account, Lieut. Williamson always spelled the name with a single t, although on most maps it is written with two. We encamped on the bank of the river, which here flowed between bluffs, from twenty to thirty feet in height, bordered by bushes. Large quantities of obsidian were found in the vicinity. The river was about thirty feet in width.

Lieut. Williamson made the following note on the day's march.

"To-day we had a level, good, but tedious ride. Opposite the middle of the valley, to the west, is an opening in the hills of considerable breadth. This looks as if the hills south of the opening were the northern slope of the range north of Fall River valley. Opposite the head of the valley the hills appear again. Near our evening camp, I went on a ridge and found hills to the westward, not at all formidable in appearance, but which would still require work to make them passable for a railroad."

August 9.—Lieut. Williamson directed me to remain in camp with the main party and observe for latitude, &c., to-day, while he, with Lieut. Sheridan and the dragoons, explored the road in advance. The heat was oppressive, but the bushes near the river bank afforded a thick and pleasant shade.

The following extract from Lieutenant Williamson's journal shows the result of his examination.

"We followed the Lassen trail for 2.5 miles, to where it crossed the river at the mouth of a small, dry branch. We here left the road to take the old Oregon trail, which was very distinct. It led north up the branch to the divide, and thence on, in the same direction, until we struck a spring branch in pine timber, about seven miles from the river. I went on top of a partially bald hill and had a view of the country. The hills followed to the north, probably inclining to the east. The rest of the country east of the meridian line appeared to be rolling, or slightly hilly, and covered with open pine timber. I was sorry I could not ascertain if the spring branch had a continuous bed to Pit river. Its course near its source was westerly;

but there is no reason to suppose that it did not bend toward the south, and discharge into Pit river about ten miles below our camp. I feel pretty sure either that it sinks, (that is, has no continuous bed,) or that it goes to Pit river. In the latter case, the railroad should follow it up."

August 10.—To-day, we travelled over the route examined by Lieutenant Williamson yesterday, and encamped at what he termed the "spring branch." It was a little creek about ten feet in width, which flowed through a small opening bordered by pine timber. The stream was so choked up with bushes, that, in many places, it could only be reached by cutting them away. Towards the lower part of the opening, the brook spread out into a little swamp. Frogs of a very peculiar species were found in the creek and swamp, in great numbers. An antelope was shot near camp.

August 11.—The party was aroused at three o'clock this morning, by Lieutenant Williamson's order; as it was very uncertain how far we might be obliged to travel before reaching water. The head of the antelope killed yesterday, had been baked by allowing it to remain all night buried among hot stones, and it furnished an excellent breakfast. We followed the wagon road through an open pine forest for about six miles, and then, finding that it inclined too much to the west, left it, and endeavored to keep, by compass, a course N. 20° W. After travelling several miles on nearly level ground through the forest, we emerged from it, and found ourselves on a rocky plain covered with sage bushes. This we crossed in about six miles, and, on reaching the summit of a line of low sandstone hills capped with trap, saw below us Wright lake. It was a fine sheet of water, about eleven miles long and four miles wide, bordered by tule. The banks were so miry that we were compelled to travel more than a mile before reaching a place where the animals could drink. We encamped in the edge of the tule, near some green willow bushes which supplied us with our only fuel, as even sage bushes had disappeared after crossing the hills.

August 12.—Our course, at first, lay along the southwestern shore of the lake, where the hills occasionally terminated very abruptly at the water's edge. The horn of a mountain sheep, weighing several pounds, was found near the trail. After crossing the low hills which border the lake, we travelled through a gently undulating region, dotted with sage bushes, for about seven miles. We then found ourselves on the edge of an abrupt descent of 200 feet, which conducted to the shores of Rhett lake. This lake was about fourteen miles long and eight miles broad. It was bordered by a wide belt of tule, the home of vast numbers of water-fowl, which rose in clouds at our approach.

On the bluff the trail joined an emigrant road, which followed down a narrow ravine to the level of the lake. This ravine was once the scene of a bloody massacre. A party of Indians lay in ambush, until an emigrant train reached the middle of the descent, and then attacked and killed nearly the whole party. Rhett lake is a secure retreat, where the savages can escape among the tule, in their light canoes, and defy a greatly superior force.

The line of hills which borders the lake on the northeastern side, is separated from the tule by a narrow strip of land, elevated but little above the water. This was covered with grass, the rich green of which presented a refreshing contrast to the sickly blue of the sage plain over which we had been travelling. The clouds of dust ceased, and we journeyed on through a much more pleasing region. After riding a few miles from the bluff, we left the road, and encamped on Lost river near where it discharges itself into the lake by several mouths. It was a deep, unfordable stream, flowing with a very sluggish current. The banks were abrupt like the sides of a canal. A few sage bushes and "bois des vaches" supplied the only fuel.

We found, encamped near the stream, a party of men that had come from Yreka to meet and escort an expected emigrant train.

August 13.—Lieut. Williamson determined to pass around the western side of Lower Klamath lake, with Lieut. Sheridan and the dragoon detachment, to examine the route, and to ascertain whether Klamath river flowed through the lake or not. He gave me instructions to proceed with the main party to Upper Klamath lake, and, after selecting a good camping place near its southern extremity, to await his arrival. Nine of the foot soldiers were sick, and they accompanied Lieut. Williamson, to be sent, in charge of a non-commissioned officer, through the pass south of Mount Pitt to Fort Lane.

My party left camp first. We followed up the eastern bank of Lost river, through a dusty sage plain almost destitute of grass, to the Natural Bridge. The river was here about eighty feet wide and very deep; but it was spanned by two natural bridges of conglomerate sandstone from ten to fifteen feet in width, parallel to each other, and not more than two rods apart. The water flowed over both of them. The top of the most northern one inclined down stream, but it was only covered to a depth varying from six inches to two feet. The other was nearly horizontal, but the water, being unusually high, was too deep for fording. There are probably hollows under both arches, through which the river flows. Emigrants cross here with their loaded wagons. There is no ford for a considerable distance above, and none below. We passed over without difficulty, and followed a well marked Indian trail towards the north, through a level valley dotted with sage bushes and a few clumps of bunch grass. The river, which was full of short bends, was often sunk as much as thirty feet below the plain. There was apparently a good ford 4.5 miles above the Natural Bridge. The valley was about three miles wide, and bordered by high hills; those on the east being well timbered with pine, and those on the west nearly bare. The bunch grass became more abundant as we advanced, and the sage bushes fewer in number. After travelling twelve miles from the Natural Bridge, we reached a place where the river issued through a cañon from the hills to the eastward; and, although the valley continued towards the north, it was entirely destitute of water. As the distance to Klamath lake was unknown, we left the trail and encamped near the mouth of the cañon. The general surface of the plain was here about forty feet above the water; but it was connected by a bench, about 200 yards in width, of not more than half that height. This formed a good camping ground; being covered with fine bunch grass, while bushes and small trees for fuel were found in abundance near the edge of the stream.

August 14.—This morning some excitement was created in camp by the discovery of a huge rattlesnake coiled up under a blanket. The reptile was killed; but, as we all slept without tents on the ground, unpleasant ideas were suggested by the incident. Our course lay towards the north, through a narrow valley thinly covered with sage bushes and clumps of bunch grass. It was bordered by timbered hills which gradually closed in upon the trail. We crossed several dry beds of streams, and also the bottom of what, in the rainy season, was undoubtedly a small lake. It was now dry, and covered with a white efflorescence. After travelling 9.5 miles we reached a low line of hills, which formed the northern boundary of the valley. Klamath river forced its way through the ridge by a narrow cañon, and, after flowing along the western side of the valley for a short distance and spreading out into a small lake, disappeared among the hills towards the west. On reaching the summit of the very low divide, composed of trap rock, we saw outspread before us Upper Klamath lake. It was a fine sheet of water, thirty miles long and twelve miles wide, bordered by timbered ridges with an occasional narrow belt of tule. Light clouds of smoke rising from signal fires upon several of the hills satisfied us that watchful





UPPER KLAMATH LAKE FROM CAMP 28.

eyes were measuring our advance. We had struck a small arm of the lake, from which Klamath river issued. Following along the eastern side, we crossed a grassy meadow, and encamped at the extremity of a hilly promontory which projected into the lake. Excellent bunch grass, with bushes and small trees for fuel, abounded in the vicinity. East of the promontory, a wide field of tule prevented approach to the water; but the western shore was rocky and bold. Snakes of various kinds were very plentiful. Several large rattlesnakes were killed before we had been in camp an hour; and I counted nearly a dozen cast off skins lying within a rod of each other. Two squaws came into camp in the afternoon, with a few fish which they had caught in the lake. We gave them some presents, and they paddled rapidly away in their canoe to spread the news. The water taken from the lake had a dark color and a disagreeable taste, occasioned apparently by decayed tule.

August 15.—We remained in camp to-day, waiting for Lieut. Williamson. Several good observations were obtained for latitude and altitude.

About midnight a sudden alarm aroused camp. The cook's fire had spread, by some dead roots, to the dry grass and bushes; and a general conflagration was prevented only by the most vigorous exertions. It was at first supposed that the Indians had kindled the fire, to engage our attention while they stampeded the mules, and this idea did not tend to lessen the excitement and confusion of the scene.

August 16.—To-day was spent in taking astronomical and barometric observations, while waiting for Lieut. Williamson. A thick haze which covered the lake, entirely concealed the opposite shore. The taste of the water was so disagreeable that several vain attempts were made to discover a spring in the vicinity.

August 17.—Lieut. Williamson with his escort came into camp at noon, having made a satisfactory examination of Lower Klamath lake. A description of his route will be found in Chapter IV. Three broken down mules of the escort train were shot to-day, and every preparation was made for an early start to-morrow.

August 18.—The ridges on the eastern side of the lake, which were composed of vesicular trap, appeared to run parallel to each other in a northeast and southeast direction, and to terminate abruptly at the water's edge. A well marked Indian trail followed along the shore; but members of the party who had explored it for a short distance reported it very rocky, and impassable for "the little cart," as the odometer wheels still continued to be termed. Lieut. Williamson had observed several Indian trails diverging to the right on his last day's march; and he therefore determined to follow a southeast course, hoping to discover some good pass by which he could cross the ridges, and thus avoid the rocks and bends of the shore. After travelling about three miles in this direction through a wooded country, he thought it best to cross abruptly a steep and rocky ridge to the east. We thus reached a narrow valley, lying between two steep ranges of hills, and filled with open pine timber. There was a large Indian trail in it, which conducted us to the lake. A precipitous and rocky ridge rose abruptly from the water, leaving barely sufficient room to pass along the bank. After travelling a short distance, we reached a point where several springs gushed from the hill side, and disappeared among thick bushes surrounded by luxuriant grass. The water was clear and pure, and Lieut. Williamson at once encamped. Elder and service berries were found in abundance. A thick haze prevented astronomical observations, and concealed the western shore of the lake. Snakes, as usual in this region, were very numerous, and one of them glided suddenly among our dishes, as we were sitting down on the ground to eat.

August 19.—This morning the trail, for three or four miles, wound along the rocky side of the ridge which bordered the lake, and was, in consequence, very rough. Huge rocks, piled near the water's edge, prevented the passage of "the little cart" by that route. The hill side was sparsely covered with scattered pines, but near the lake shore springs were numerous, and the growth of bushes was often dense. Bartee, the guide, shot three bald eagles with his rifle, as we passed along the base of the crags upon which they were fearlessly resting.

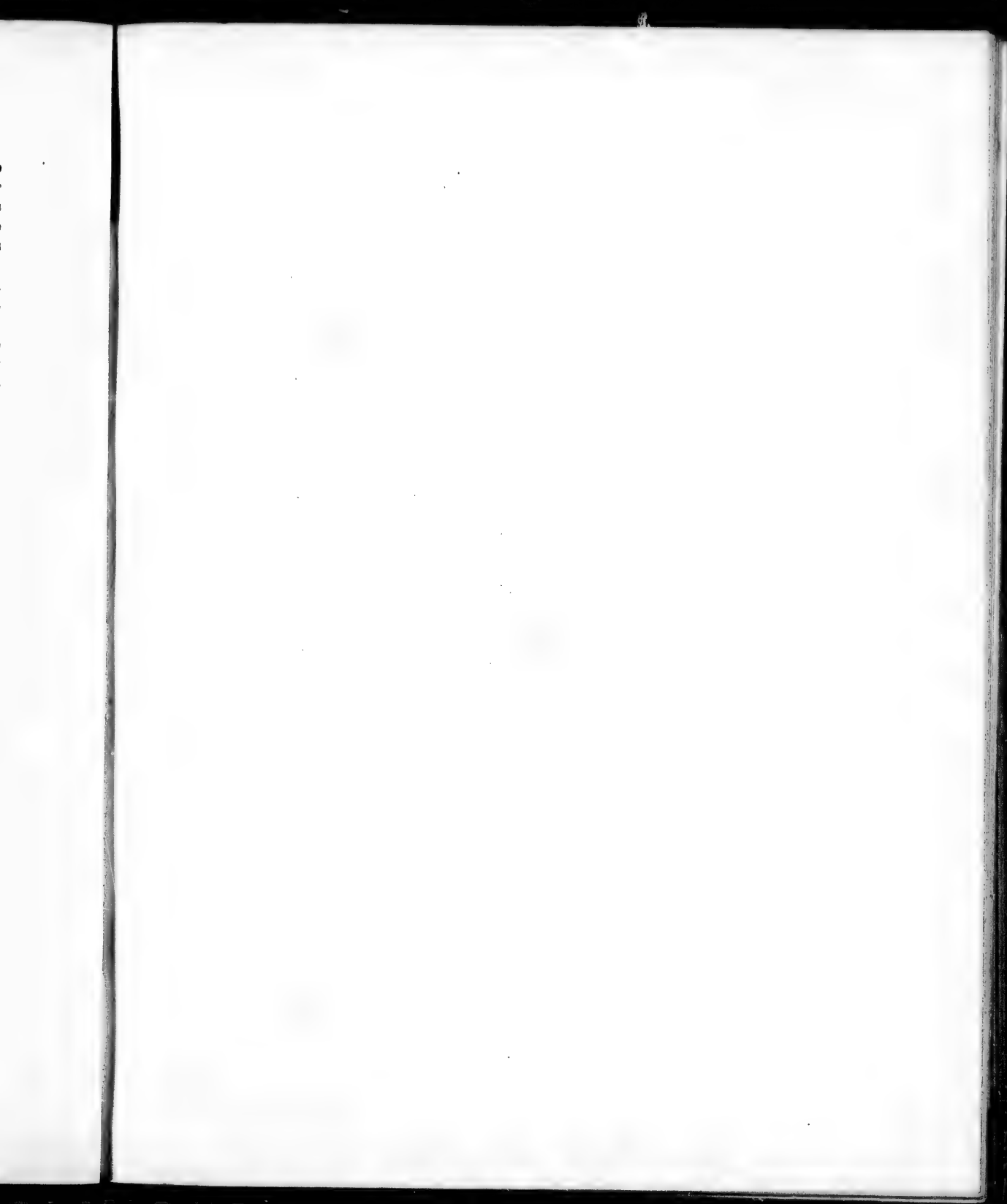
In riding under the projecting limb of a tree, Mr. Daniels was knocked from his mule and quite severely injured. The country had recently been burnt over, and the want of grass compelled Lieut. Williamson unwillingly to continue the march. The trail soon diverged from the lake shore, and after passing over a dry plain entered an open pine forest. In a short time we found ourselves on the banks of Klamath river, which was flowing through a fine, grassy bottom, marked by a few clumps of willow bushes. Here we encamped. The river was about 150 feet in width, and apparently quite deep. There was a ford, however, a short distance below. Every requisite for a good camp ground was found in abundance in the vicinity.

August 20.—Mr. Daniels was much better this morning and able to ride his mule.

As had been usual of late, a dense fog obscured the view for two or three hours after starting. Our course lay up the eastern side of the beautiful valley of Klamath river. The bottom was at first open, covered with green grass, and bordered by low timbered hills. We passed several cliffs of basaltic breccia, from twenty to fifty feet in height, and occasionally ornamented with rude, Indian paintings. The current of the stream was not very rapid, and there appeared to be several fords. The trail crossed one large and fine tributary which flowed swiftly over a rocky bed. After travelling twelve miles from camp, we reached the mouth of a cañon from which the river emerged. The sides were of basaltic rock and pumice-stone, and very steep. Lieut. Williamson estimated their height at 1,000 feet at the highest points. We followed the trail over the ridge on the eastern side of the river, and several times looked down into the cañon. Its course appeared to be straight in the main, but small bends were numerous. The ridge was heavily timbered with pine. The forest was on fire, and an occasional heavy crash reverberating for miles, warned us to beware of falling trees. The cañon was about four miles in length. A short distance beyond its northern entrance, we emerged from the forest and entered a lovely meadow, covered with clover and fine green grass. The ground was miry near the river, which was deep and sluggish, and we encamped at the edge of the timber. The meadow appeared to be an arm of Klamath marsh, and was evidently flooded at seasons of high water.

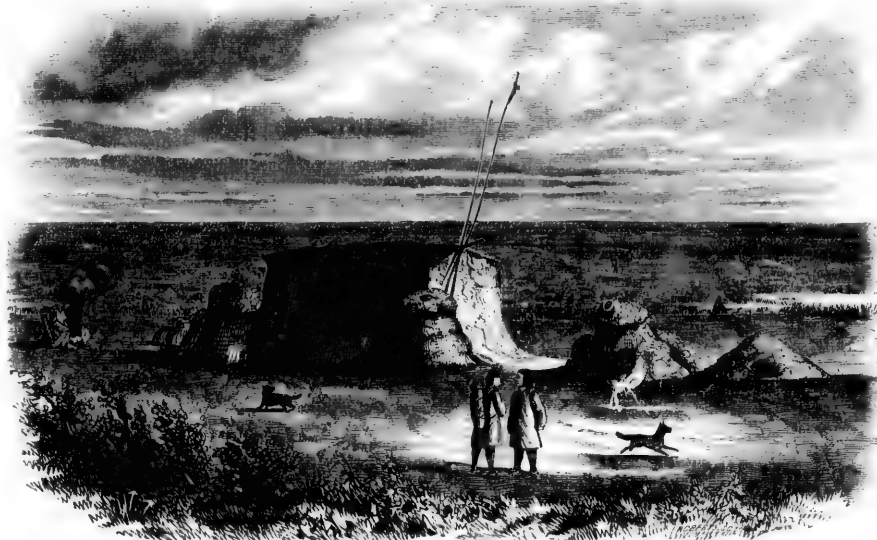
August 21.—This morning at daybreak, the fog was so dense that we could not see fifty yards in advance, but the sun soon caused it to melt away. The trail led us over a thickly timbered ridge which projected into the meadow. The soil was light pumice-stone dust, and fallen trees rendered travelling somewhat difficult. At the northeastern base of the ridge we reached the shore of Klamath marsh. This was a strip of half-submerged land, about twelve miles long and seven miles broad. It was covered by clumps of tule and other aquatic plants separated by small sheets of water. Thousands of ducks, plover, and other water birds, made it their home. They were so tame that they would hardly fly at the report of a gun, but it was useless to shoot them, as the deep mud rendered it impossible to secure them afterwards. We surprised two Indians on the shore, and endeavored to make them understand that we were friendly; but they evidently distrusted our professions, and escaped as soon as possible.

Lieut. Williamson decided to follow the eastern shore of the marsh. We soon reached a collection of Indian huts built near the edge of the water. Our two friends had evidently been there before us, for the rancheria had been very recently deserted. Large quantities of food,





consisting mostly of seeds of water plants and dried fish, several canoes made of hollowed logs, many baskets formed of reeds curiously woven together, and divers other valuables, were scattered around in wild confusion. The fires were burning in front of the huts, of which there were three distinct kinds. The summer lodges had vertical walls supporting flat roofs. They were composed of a framework of sticks, covered with a matting of woven tule. The winter huts were shaped like bee-hives, and made of sticks plastered with mud. We noticed only one of the third kind, which was apparently used for a council house. A hole, about four feet deep and ten feet square, had been excavated, and the earth heaped up around the sides. Large sticks planted in this mud wall supported a roof made of cross poles covered with earth. The entrance was by a flight of mud steps that conducted to the roof, from which a rude ladder led through a hole to the floor below. Each of these structures is represented in the accompanying wood cuts, together with some conical graves described below.



The dusky inmates of the rancheria had betaken themselves to their canoes, and retreated among the tule to what they considered a safe distance. They now stood, yelling like fiends and shaking their weapons at us in impotent rage. Strict orders had been given that none of their property should be injured; and we passed rapidly along the shore of the marsh, surprising a new rancheria at almost every turn. The number of these savages is very large; and nature has given them so secure a retreat, that only a greatly superior force provided with boats, could attack them to advantage. They paddled through openings among the tule, and thus accompanied us, uttering hideous howls when the labor of working their passage did not keep them quiet. We passed on the way one of their burial places. The bodies had been doubled up, and placed in a sitting posture in holes. The earth, when replaced, formed conical mounds over the heads. Near the other graves, but on a slight eminence, stood a new wall-tent, such as is used in our service. It was regularly pitched and the front tied up. On look-

ing inside, we saw a large mound about two feet in height, the base of which covered the whole space enclosed by the walls. A new blanket was spread over the top. Here, doubtless, was the grave of some great chief; but how the savages became possessed of the tent remains a mystery. Along the whole chain of Klamath waters we noticed, in many places, large



stones laid one upon the other, forming piles from two to six feet in height. Some of the party thought that these were marks to show the trail when the ground was covered with snow; but the vast numbers of them sometimes found within a few feet of each other, and their frequent proximity to trees which could easily have been blazed, rendered this hypothesis rather improbable.

After travelling about sixteen miles from the place where we first struck the marsh, we reached a part where it was not more than a mile wide. Seeing several mounted Indians hastily driving a number of horses across, we attempted to follow, but found the ground too miry for pack animals. As it was almost sundown, Lieut. Williamson decided to encamp near some trees on the shore. The only water was that found stagnant on the surface of the marsh. The grass was good, but it had been eaten quite short by the Indian horses. As we had been careful to do the savages no injury, they began to doubt our hostile character, and sent in a few squaws as an experiment. As they were dismissed with presents, large numbers of men entered camp, and made great professions of friendship. We distrusted them, however, and kept a close watch upon the animals during the night.

August 22.—This morning many Indians came into camp. They were all well dressed in blankets and buckskin, and were armed with bows and arrows and a few fire-arms. Their intercourse with the Oregon settlements had taught many of them to speak the Chinook, or Jargon language, and one had a slight knowledge of English. They owned many horses, some of which were valuable animals. No offer would tempt them to sell any of the latter, although they were eager to dispose of a few miserable hacks too worthless to purchase.

The idea, which prevails in Oregon, that all Indian horses are of an inferior breed, doubtless arises from the fact that such only are brought to the settlements for sale. Near Klamath marsh we saw a few animals of a piebald color, whose graceful forms and clear, piercing eyes showed very superior blood. It may be that their genealogy extends back to the Barbary steeds introduced by the Spaniards into Mexico, and supposed to be the progenitors of the wild horses of the prairies.

Near the spot where we were encamped, the marsh was not more than a mile in width; but it extended an indefinite distance towards the east, and the Indians informed us that the journey round it was very long, and without water. They volunteered to show us a natural causeway to the other side; but it proved too miry for pack mules. Our new friends all declared that the best trail to the Des Chutes valley led round the western side of the marsh; and Lieut. Williamson finally decided to turn back and try that route. We followed almost the same trail as yesterday, and encamped near the southern point of the marsh.

A large number of Indians accompanied us, one of whom Lieut. Crook had formerly seen in Yreka. These savages were intelligent, and in every way superior to those of Pit river. By questioning them in Chinook, Lieut. Williamson, assisted by Lieut. Crook, obtained the following partial vocabulary of their language.

VOCABULARY OF THE KLAMATH LANGUAGE.

ENGLISH.	KLAMATH.	ENGLISH.	KLAMATH.
Acorn	stup-ultz	Feet	patz
Alive, life	muk-lux	Fingers	spal-o-wish
Arm	shish-am-e-ny	Fire	lo-lux
Arrow	ky-ish	Fire-wood	an-co
Autumn	schoh	Friend	tit-si
Axe, hatchet	schlak-ote	Girl	na-watz'-ka
Bad	ko-its	Good	titch-i
Bark	ntsh-atz	Grass	ksoon
Beard	smokl-smankl	Great, big	ah-tay-ne
Bird	yoke-ul	Green	ma-ax
Black	wush-push-li	Hair	lak
Blood	tcha-co li	Hand	nap
Blue	ketch-ketch-o-li	Has	tsho-nash
Bone	ka-ko	Head	nos
Bow	ty-ish	Heart	sty-mas
Boy	kitch'-ca-ne	Hill	kin-ka-ny
Bread	sap-pe-lill	House	lat-sus
Canoe	wountz	Indian shoes	wuk-schu
Chief	lak-i	Infant	mu-kak
Cold	kah-ti-kah	Iron	wah-ti-ti
Cow	mus-a-mus	Kettle	po-ko
Day	uy-i-ta	Knife	wah-ti
Dead, death	klah'-ka	Leaf	ta-pac
Deer	lil-hunx	Leg	tsoak
Ear	mo-mo-watz	Lightning	lu-i-pols
Earth, land	kshun	Man	hish-watz
Evening	lit-kah	Money	dollar
Eye	lolpe	Moon	sa-pas
Father	ptic-up	Morning	po-sant

Vocabulary of the Klamath language—Continued.

ENGLISH.	KLAMATH.	ENGLISH.	KLAMATH.
Mother	kis-up	Star	kitsol
Mountain	whal-laco	Stick	kose
Mouth	shum	Stone, rock	ky
Nails	staks	Squirrel	tsutz-tsac
Neck	ne-is	Summer	pa-ta
Night	pshin	Sun	wy-tah
Nose	pshish	Thou	naw
Old man	chick-ah	Thunder	le-mais
Pipe, calumet	pa-ux-pox	Tobacco	kotz-kul
Pistol	an-co	Toes	spal-o-wish
Rain	klote-sus	Tongue	pa-watz
Red	tak-tak-o-li	Tooth	tote
River	ko-kah	Town, village	to-me lat-sus
Saddle	kok-lus	Tree	wah-ko
Salmon, fish	tchi-altz	Warm	walks
Sea	an-pu-al-la	Water	am-bo
Shirt	tsho-lish	White	pol-pol-i
Sky, heaven	pit-eye	Wind	scla-wa-is
Small, little	wik-a-ne	Winter	lol-dum
Snake	kah-is	Woman	schnah-watz
Snow	che-ish	Yellow	kak-kak-o-li
Spring	schoh		

August 23.—This morning we started with a large retinue of savages. The trail led through open pine timber for about a mile, and then entered a fine, grassy meadow which extended towards the north to Klamath marsh. About three miles from camp we reached Klamath river, here a sluggish stream divided into two branches by a narrow island. The water rose to the backs of the smaller mules, and Lieut. Williamson employed the Indians to transport the packs across in canoes. This the squaws, who perform all the work, did by paddling round the northern end of the island. After paying their husbands with red blankets, beads, and vermilion, which they appear to highly prize, we continued our course through the grassy meadow until we reached a clear, ice-cold stream flowing through open timber. Here we encamped. The brook rose in springs about a mile from where we struck it, according to the report of the guide, who shot three antelopes near its source in the afternoon.

August 24.—This morning the Indians left us. We followed a large but crooked trail through a thick pine forest. Fallen timber of small size somewhat obstructed the way, but there were no hills. The soil was light volcanic ashes, in which the animals sank nearly to the knee if they left the beaten trail. The dust was stifling. About 13.5 miles from camp, we reached the dry bed of a stream which was fringed with willows but entirely destitute of water. About five miles further on we came to a water hole, and, as it was nearly sundown, Lieut. Williamson decided to encamp, although there was no grass. The water was good, but the hole filled slowly, and the supply was scanty. Two more holes were dug a short distance further up the ravine, but most of the animals passed the night suffering from both hunger and thirst.

August 25.—To-day we continued our march through a country similar, in all respects, to that

traversed yesterday, except that it became slightly undulating. The dense clouds of dust raised by our animals from the ashy soil were suffocating. After riding about 18.7 miles from camp, we suddenly emerged from the dense forest, and found ourselves in the beautiful grassy bottom of the Des Chutes river. It was here a fine stream about thirty feet in width, and fordable although the current was rapid and the bed stony. We immediately encamped. At the water hole, this morning, two trails diverged. We followed the more easterly one; but two of the party by mistake took the other, which was equally large. It conducted them to a point further up stream, and was doubtless a trail leading to the wagon road across the Cascade Range, which Lieut. Williamson subsequently examined. The supply of grass to-night was abundant, and of fine quality; the water was cold, and the position in every respect excellent for a camp. Large numbers of delicious trout, marked with red longitudinal stripes, were caught with great ease in the river.

August 26.—This morning we left the bank of the stream, and followed the trail for about seven miles through a pine forest. It passed over several low hills, upon which the soil was light and ashy. As it wound considerably towards the east, Lieut. Williamson was afraid that it might leave the river entirely, and lead to the Wallah-Wallah country. He therefore abandoned it, and turned again towards the stream, which was reached in about 1.5 miles. We crossed it at a good ford, and, to our great surprise, came upon an old nearly effaced wagon trail. This we followed with difficulty for a short distance, when it seemed to disappear in a thick growth of young trees and underbrush. After struggling forward for a short distance, we recrossed the river and again struck the wagon trail, which must have crossed to the eastern bank, near where we entered the bushes. We followed it down the river. The soil during the whole day's march was light and ashy. The country had been recently burned over by the Indians; and we were beginning to despair of obtaining forage for our animals, when a sudden bend revealed a portion of the river bottom thickly carpeted with luxuriant grass. Here we encamped under a few small trees. The river, which was about forty feet in width, flowed through a grassy bottom bordered by low bluffs, distant about 200 yards from the stream. The current was rapid, and the water clear and cold. Trout were abundant and easily caught.

August 27.—To-day we remained in camp, and Lieutenant Williamson made preparations to start to-morrow with Lieutenant Sheridan and the dragoon detachment, to begin the examination for a pass through the Cascade Range to the Willamette valley. The soil was so light that I found it impossible to take astronomical observations near camp. The ordinary movements of the men and animals caused a continual shaking of the ground, which disturbed the mercury of the artificial horizon, although surrounded by a trench nearly two feet in depth. It was consequently necessary, for every observation at this camp, to carry the instruments about an eighth of a mile to the bluffs above the river bottom. In the night, Lieutenant Williamson and others of our mess were taken violently sick. It was supposed by some that we had been poisoned by eating trout caught in the river; but I think that the sickness was probably occasioned by some carelessness of the cook.

August 28.—Although Lieutenant Williamson was quite unwell this morning, he started with Lieutenant Sheridan and the dragoons for the mountains. An itinerary of his trip will be found in Chapter IV. The main party remained under my charge in camp, where the customary observations were taken. Many crawfish, which when cooked were scarcely inferior to lobsters, were caught in the river.

August 29.—As the supply of grass began to fail, I moved camp about 3.3 miles down stream this morning, to a point where the river bottom spread out into a fine prairie, carpeted with an abundance of rich bunch grass. To reach this prairie, we passed through a nearly level country covered with pine forest. We encamped near some small trees on the river bank, where we found all the requisites for an excellent camping place. During the night, ice of considerable thickness formed in the water vessels, and just before sunrise the thermometer stood at 15° Fahrenheit.

August 30.—The day was spent in taking observations and computing. The glass crystal of one of the chronometers was unfortunately broken; but Mr. Coleman pounded a piece of tin until he gave it the requisite curvature, and thus supplied an admirable substitute. He had previously repaired a watch in the same manner.

August 31.—We remained in camp taking the usual observations. Early in the morning the air was quite uncomfortably cold, and the thermometer ranged below the freezing point until nearly nine o'clock. The altitude of the camp above the sea was only 4,129 feet.

September 1.—To-day we were greatly surprised by the arrival of a party of gold seekers from the Umpqua valley, who were journeying to the Coleville mines. They had crossed the Cascade Range by the wagon road south of Diamond Peak, which Lieutenant Williamson subsequently examined. After remaining a few moments with us, they continued their march. In the afternoon a corporal and two men arrived, bringing me orders from Lieutenant Williamson to join him on the second tributary of the Des Chutes river below camp.

September 2.—Our course this morning lay through a fine prairie, from half a mile to two miles in width, and bordered with pine timber. The river wound through the middle of the open space, concealed from view by a line of willows, and the trail followed its general course. The soil was mostly of a pumice-stone character, but there was an abundance of fine grass. After travelling 13.5 miles we found, by the greatly increased size of the stream, that it had received a tributary from the mountains. As the bushes were too thick to admit of riding near the water's edge, I walked back, and in about a quarter of a mile reached the junction of the two branches. The new tributary was too large to ford, and the depth and swift current of the main river threatened to give us much trouble in crossing. Beavers were very numerous in this vicinity. Continuing our march we soon reached a place where the trail crossed to the other bank; but the ford was so deep that the water rose to the backs of our largest mules. After searching in vain for a more shallow place, I decided to make rafts, rather than wet the packs and endanger the animals by driving them loaded into the swift current. The men worked hard, and at sunset all our packs and instruments had been transported to the western bank in safety, on a raft formed by lashing dry logs together. The escort were not quite so successful, and some of their property remained on the eastern bank until morning. The river was about 150 feet in width; the bottom was hard and free from boulders, and the banks were low and firm. The depth of the water and the swift current alone prevented fording.

September 3.—In examining the vicinity of camp this morning, I found the remains of an old Indian rancheria, surrounded by numerous deer and elk horns. A little above the crossing place on the western bank, several springs gushed from the rocks and united to form a stream nearly fifteen feet in width, which discharged itself into the river.

We started at about eight o'clock. The trail led near the river bank, through a pumice-stone region covered with pine timber. There were a few hills, and they gradually increased in height and steepness as we advanced. The river abounded in short bends. About five miles from camp, trap rock suddenly took the place of pumice-stone, and the stream entered

the great cañon, which undoubtedly continues, without much interruption, to its mouth. The descent of the river in this cañon is shown by our barometric observations to average about twenty-five feet to the mile. A bend in the trail soon brought us to the summit of a cliff above the water, and revealed a scene wild and beautiful in the extreme. The opposite bank was composed of huge masses of trap rock, piled one upon the other in wild confusion. About fifty feet below us, the river was leaping, with a low murmuring sound, from crag to crag and apparently descending one hundred and fifty feet in less than three hundred yards. The dark pines around us, and the remains of a deserted Indian rancheria, harmonized well with the scene.

After crossing several steep ridges, separated by small ravines, the trail left the river and passed over an elevated plain densely timbered with pine. A few miles further on, we descended abruptly into a narrow gorge, which conducted us to a small tributary. Here we found Lieut. Williamson in camp, and an abundant supply of good grass and water. The bottom was bordered by bluffs, about one hundred feet high, which approached each other and increased in height, both above and below camp. Immediately after our arrival it began to rain, for the first time on the survey. Some of the party, who had followed down the river beyond the point where I left it, arrived thoroughly wet, a short time before sunset. They reported their route execrable.

September 4.—This morning, after riding a few miles, we emerged from the forest, and traversed an elevated plateau, dotted with cedars and sage bushes, and marked by a few low ridges and ravines extending in a northeast and southwest direction. None of these ridges were over 300 feet in height. The air was uncommonly clear and pure. The white summits of several snowy peaks began to appear in the distance, and we pressed rapidly forward. After travelling 17.5 miles from camp, we reached Why-chus creek, near the place where Lieut. Williamson had encamped on September 1st. It was a fine stream, about 30 feet in width, flowing rapidly over rounded rocks. Its waters were slightly turbid. There was an inexhaustible supply of fine grass in the vicinity, but Lieut. Williamson decided to travel on, and encamp near the "forks of the Indian trail." We passed through an open forest for the whole distance, and encamped on a little brook which, a few miles below us, sank among the rocks. From a slight eminence above camp, the snowy peaks of the Three Sisters appeared quite near. A large meadow, which Lieut. Williamson had previously seen, and upon which he depended for grass, proved to be a cranberry swamp and utterly impassable. A sufficiency of excellent bunch grass, however, was found among the trees. Whortleberries, elder berries and service berries abounded in the vicinity.

September 5.—To-day we remained in camp, and I repaired the barometer which had been broken on the recent trip among the mountains.

Lieut. Williamson instructed me to proceed to Fort Dalles to obtain provisions, and to examine the Des Chutes valley, while he continued the exploration of the mountains in the vicinity. As I had charge of a detached party during the remainder of the survey, it may be well to give a brief synopsis of the movements of each division of the command, in order to render the subsequent part of the report more intelligible. Lieut. Williamson continued his explorations among the mountains while I went to Fort Dalles. I rejoined him at Camp S, near Why-chus creek, and we again separated. He returned to the head of the Des Chutes valley; examined the pass south of Diamond Peak; proceeded to Vancouver, and thence by water to San Francisco. I explored the vicinity of Mount Jefferson; returned nearly to the Dalles; and then, crossing the Cascade mountains by a new pass south of Mount Hood, went to Vancouver. From that post I proceeded, by way of Fort Lane and Fort Jones, to Fort Reading, where the field work ceased. The next chapter contains itineraries of the routes followed by Lieut. Williamson.

CHAPTER IV.

NARRATIVE AND ITINERARY CONTINUED.—ROUTES OF DETACHED PARTIES IN CHARGE OF LIEUT. WILLIAMSON.

EXPLORATION NEAR LOWER KLAMATH LAKE.—PARTY.—WHITESTONE.—LOWER KLAMATH LAKE.—KLAMATH RIVER.—LETTERS.—CAÑON.—PASSAGE OF RIVER THROUGH LAKE.—UPPER KLAMATH LAKE.—RAFT.—JUNCTION WITH MAIN PARTY.—FIRST EXPLORATION AMONG THE CASCADE MOUNTAINS.—PARTY.—FINE MEADOW.—SNOW PEAKS.—LAKES.—VIEW FROM MOUNTAIN.—INDIAN TRAIL.—CASCADE.—EXTINCT CRATER.—SUMMIT OF DIVIDE.—THREE MEN SENT BACK.—INDIANS.—FORKS OF TRAIL.—WHY-CHUS CREEK.—JUNCTION WITH MAIN PARTY.—SECOND EXPLORATION AMONG THE CASCADE MOUNTAINS.—PARTY.—EXTENDED VIEW.—SNOW.—LAKES.—TRAIL DISAPPEARS.—CAÑON.—COMPELLED TO TURN BACK.—DEPOT CAMP AGAIN.—SECOND START.—DIFFICULT ROUTE.—EXTENDED VIEW.—TRAIL DISAPPEARS.—ROUTE IMPASSABLE.—COMPELLED TO TURN BACK.—RAIN.—INDIANS.—BAROMETER BROKEN.—RETURN TO DEPOT CAMP.—NEW ROUTE.—ELK KILLED.—ASTRONOMICAL OBSERVATIONS.—ROUTE FROM CAMP S ON WHY-CHUS CREEK TO VANCOUVER.—FINAL DIVISION OF PARTY.—START.—WAGON ROAD.—MAIN DIVIDE.—LAKES.—MIDDLE FORK OF WILLAMETTE RIVER.—ROUTE IN RAVINE.—FIRST SETTLEMENT.—SPORE'S FERRY.—BROKEN DOWN HORSES LEFT BEHIND.—FENCES.—SOUTH FORK OF SANTIAM RIVER.—NORTH FORK.—OREGON CITY.—FORT VANCOUVER.—SUBSEQUENT MOVEMENTS OF LIEUT. WILLIAMSON.

THESE itineraries have been compiled entirely from Lieut. Williamson's field notes, as I did not accompany him on the expeditions. As his journal was written hastily and without any view to publication, considerable revision has been necessary—so much, indeed, as to preclude the use of quotation marks. I have, however, been careful to adhere to his own words as far as possible.

EXPLORATION NEAR LOWER KLAMATH LAKE.

August 13.—I started this morning with Lieut. Sheridan and the dragoons to follow round the western side of Lower Klamath lake, having directed Lieut. Abbot to pass with the main party up the eastern side, and rejoin me near Upper Klamath lake. I crossed Lost river at the Natural Bridge, and then proceeded on the Yreka trail to where the Oregon trail diverged from it. We travelled to-day about twenty miles and encamped on a stream, ten feet wide, which flowed from springs at the foot of a neighboring hill.

August 14.—About a mile from camp I saw a white spot on the road, and found that the ground became white as I approached it. On the spot itself were fragments of a white, soft stone, apparently clay. A piece was preserved for examination. About four miles from camp we crossed a fine spring branch, rising at the foot of hills within one hundred yards of the trail, and apparently joining the one on which we had encamped, near Lower Klamath lake. Three miles further on we crossed another spring branch emptying into the lake. About two or three miles further on we skirted the western side of the lake. The body of water was small, but a large marsh extended for about ten miles towards the north. We soon entered pine timber, and after crossing a pretty high divide reached Klamath river, a short distance from the lake. The sick men were better. I prepared letters for the War Department, to send by them to Fort Lane.

August 15.—Within half a mile of camp, the river came through hills forming a cañon. We were obliged to ascend the ridge, and follow it for about six miles. We then descended, forded the river, and soon reached the edge of the marsh. Our course thus far to-day had been nearly parallel to that of yesterday. After taking several compass bearings, we followed a northerly

course to a spring on the edge of the marsh, where we encamped. The river comes into the marsh, curves through it, and passes off to the cañon, without any visible connection with the main body of water in the lake, which lies further to the southward. Doubtless, in the rainy season, the water covers the whole marsh, and then the river literally passes through the lake. Several deer were killed to-day; one of which, a very fat buck, was supposed to weigh over two hundred pounds. The sick men were sent this morning, through the pass south of Mount Pitt, to Fort Lane.

August 16.—We started this morning to follow up the Klamath river. Much to our surprise, we came at noon to an arm of a large lake from which the river flowed. This proved to be Upper Klamath lake. It was difficult to say where the connecting river ended and the lower lake began. Where the tule ceased, the river ran rapidly between low hills backed by higher ridges and was full of rapids. In one place there were falls from five to ten feet high. We found the river everywhere too deep to ford. At the rapids, where many rocks rose above the water, there were numerous deep holes; and near where it emerged from the lake it was twenty feet deep. We fortunately found two old canoes, and lashing them together, formed a raft upon which we carried our baggage across. The animals swam over without accident. We encamped near the spot.

August 17.—This morning the sentinel did not arouse camp at the time ordered, and it was about eight o'clock before we were ready to start. We soon reached the main party, which we found in camp on the lake shore. They had been waiting for us two days.

FIRST EXPLORATION AMONG THE CASCADE MOUNTAINS.

August 28.—I left Camp 37 this morning, accompanied by Lieutenant Sheridan and the dragoons, to explore the Cascade mountains near the head of the Des Chutes valley, leaving the main party in Depot camp. We carried provisions for seven days. We were compelled to descend the river about a mile before we could find a ford. Having crossed, we took a course a little north of west, and in five miles struck the main river, which was sometimes one hundred yards wide, and not fordable. Before reaching it, the trail gradually ascended, and then abruptly descended to the water's edge. After following the river for a short distance, we made an early camp, as I felt quite sick.

August 29.—Bartee, the guide, had followed up the creek yesterday, and found that, by going towards the base of a mountain southwest of us, we could shorten the distance. We therefore struck through the timber, and came to the river again in about five miles. The stream had diminished so much in size that we inferred it had forked. In following it down to ascertain the fact, Bartee killed a deer. I made a short halt, and sent a small party ahead to look for the branch. They found it, and reported it larger than the one upon which we were. We therefore struck across, and reached it at a point about a mile above the junction. It was not always fordable, but we soon succeeded in crossing. A few miles from the junction we came to a meadow, five or six miles in diameter, in which the stream again forked, both branches being too deep to ford. We followed up the north branch to the timber, and encamped. It was too cloudy to take astronomical observations to-night.

August 30.—We tried to cross the branch this morning at various places, but did not succeed until we had travelled 1.5 miles. Before crossing we came in sight of several snow peaks; and the stream was so large, and the view towards the peaks presented a prospect so favorable for a good pass, that we determined to follow the north branch, leaving the other, although it was the larger of the two. Our course lay sometimes through open meadows, and sometimes

among a dense mass of young trees and fallen timber, until we reached a lake a mile in diameter, which received no tributary and was evidently the source of the stream. A short distance beyond was another and larger lake with no outlet. We encamped on the small lake, and Lieutenant Sheridan and myself ascended a bald hill, about three miles distant, the summit of which was nearly two thousand feet above camp. We had an extensive view. To the westward was a low ridge connecting with the snow mountains. This ridge may be the crest of the Cascade mountains, but there were successive ranges beyond it, some of which appeared to be very high, and thirty miles off. There was no snow on them. Between two overlapping ridges we saw a faint line of mountains, indefinitely distant and scarcely visible. To the northward were the snow peaks, which we afterwards found to be the Three Sisters. Two only were distinctly visible, but peaks of others were seen behind them, apparently separated by low depressions. Between us and the nearest ridge were several lakes, nearly a dozen in all. It afterwards proved that others were hidden from our view. To the southward we saw a large lake at the base of a saddle peak. It was six miles or more in diameter, and was evidently the source of the other fork of the stream which we had been following. To go to the westward among the mass of mountains, I saw would require more time than I could spare, and I finally determined to cross the divide among the snow mountains, which might prove to be the crest of the Cascade Range. We returned to camp a little after sunset.

August 31.—Our course to the depression between the two snow peaks was nearly north. The ground was covered with volcanic rock in ridges and masses, with steep irregular ravines between. About ten miles from camp, we reached a good sized lake at the base of the snow peaks. We here struck an old Indian trail which led us to the depression. In ascending, we came to a beautiful little valley with a stream flowing through it towards the lake. This stream issued from the hills with a vertical fall of about thirty feet. We at length reached the summit of a ridge, which we supposed to be the culminating point. Its height above the sea was 6,303 feet. We then descended to a series of small lakes, one or two hundred feet below the crest just passed, and lying immediately at the base of the snow peaks. The trail again began to ascend, and, at length, reached the summit of a ridge about five hundred feet higher than the first. On looking back we saw plainly that we had crossed an extinct crater, which had thrown to the southward the immense streams of lava we had passed over. Descending on the Indian trail, we encamped on a little brook with a red earth bottom. Its valley was small, but there was a little grass. The night was cold and windy, and the sky obscured by clouds. I sent a corporal and two men back with instructions to Lieutenant Abbot to move camp to the second branch below.

September 1.—To-day we resumed our march on the trail. We soon overtook two mounted Indians, a male and a squaw. The latter disappeared as soon as possible, but the man proceeded with us a short distance, and then went off at a gallop to join his comrade. He spoke a little Chinook, and gave us to understand that the trail soon forked—one branch going to the Dalles, the other to the Willamette valley. About nine miles from camp we reached the forks. After riding a short distance on the northern branch, we left it to follow down a small brook which we had seen near the forks. This soon became dry, but its rocky bed conducted to a considerable stream, a branch of the Des Chutes, called by the Indians Why-chus. Here we encamped. Our barometer was unfortunately broken to-day.

September 2.—This morning we crossed over to the next branch, where we expected to meet Lieut. Abbot, but he was not there. The road was good, and practicable places could be found





for a railroad ; but still there were low ridges, with gullies between them running northeast, which would have to be crossed. None of them were more than 200 or 300 feet in height.

September 3.—To-day the main party arrived, having been delayed by the necessity of rafting the river.

SECOND EXPLORATION AMONG THE CASCADE MOUNTAINS.

September 6.—I left Camp 40 to make a second exploration among the mountains this morning, accompanied by Lieutenant Sheridan, Messrs. Fillebrown and Young, Dr. Newberry, Bartee, and the dragoons. Lieutenant Abbot started with a small party for Fort Dalles, and the main body of the escort remained in Depot camp.

The trail passed to the north of the northernmost snow mountain, and crossed the divide at a point much higher than some others visible a few miles further to the north. We had a fine view of Mount Jefferson, Mount Hood, and Mount Adams. Southward, two of the four snow peaks forming the Three Sisters, loomed up quite near us. There was snow on the trail near the divide. The ascent was steep, and impracticable for a railroad. Looking to the north and east, however, the prospects were more favorable. A high, lone mountain, six or eight miles north of us, interrupted the view, but it was evident that by going northwest from "Camp I," on Why-chus creek, and skirting the northern base of the mountain, the divide could be reached at a much lower point, and the long sweep would decrease the grade. The distant view we had would not leave a doubt as to the perfect practicability of this route ; but a closer examination might reveal many unexpected obstacles. It, however, seemed to be the only feasible line between the Three Sisters and Mount Jefferson ; and it looked more favorable than the route south of the Three Sisters.

Looking westward, we saw mountains beyond mountains, one mass without any apparent regularity or design, except that we saw the ordinary illusion of a system of ranges perpendicular to the line of vision. Whether we were on the main ridge of the Cascade Range, when on this divide, I do not know. Four small lakes lay to the westward, between the ridge upon which we stood and another, parallel to it but much lower. There seemed to be a water-course from these lakes towards the north, but it may have been an illusion. A little south of west was the deep ravine of a stream which received a branch from Mount Jefferson and one from the south.

From the divide we descended by a gradual slope, and encamped near the lakes. The grass was poor and scanty, and a much better camping place had been passed a mile or two back.

September 7.—The trail led towards the west, this morning, over the low ridge that borders the lakes. A dry water-course, which we crossed before ascending, wound towards the north, and may or may not conduct to the Des Chutes. The strong probability is that it does not. On the crest of the ridge I halted the command in a whortleberry patch, while I went up on a small eminence, from which I could see the cañons of the rivers, apparently about five miles off. The only grass in sight was in a meadow in the main cañon, near the junction of the two branches. After advancing a short distance, the trail gave out where there was some grass and a few small lakes. It seemed probable, either that the trail led to this spot merely for pasturage, or that it was a branch from a main trail which we had missed near our last camp. While advancing towards the cañon, we became entangled in fallen timber and thick forests, and were compelled to cross several steep ravines, in one of which we found water. Finally, on reaching the edge of the cañon, we saw the river flowing more than 1,000 feet below us. To descend the precipice proved to be impossible, although we tried at several places. Abandoning all

hope of obtaining grass, we at length turned back to encamp in the ravine where we had seen water. It was after dark when we succeeded in reaching our destination.

September 8.—As the animals were suffering from want of grass, and as it was impossible to advance, we went back as far as the whortleberry patch and encamped there. I took a different route, hoping to find it better, but I was disappointed.

September 9.—In order to make a thorough examination for the Indian trail, if any existed, I determined to remain in camp to-day while Bartee went in search of it. He returned at night, and reported that he had found a trail leading north from the lake on which we had encamped on the evening of the 6th. He had followed it for several miles. As there was no other course to pursue, I determined to examine this trail to-morrow.

September 10.—We followed the trail which Bartee found yesterday. In five or six miles it joined our trail from the summit of the main ridge to the lakes. We continued on and encamped at Camp 40, where we had all separated. We found that Lieut. Crook had moved the Depot camp to Why-chus creek.

September 11.—I remained in camp to day, and sent to Lieut. Crook for more provisions. My plans for the future were to follow the trail toward the south and take any fork leading to the west, in the hope of reaching the Willamette valley.

September 12.—This morning I followed the old trail towards the south, crossed the divide among the Three Sisters, and encamped on the mountain brook.

September 13.—This morning we followed the Indian trail, with a general southwest course, and crossed the divide of the Cascade Range. Many ridges and ravines rendered the route utterly impracticable for a railroad. In the afternoon the trail forked; we took the right hand branch, and encamped on a little brook bordered with grass. Directly east of our camp the summit of the main ridge was very much lower than where we crossed. The night was cloudy.

September 14.—This morning the trail led towards the northwest. From a hill covered with whortleberry bushes we obtained a fine view, and saw that our course from the snow mountains had been winding around the heads of some very deep, steep ravines. We descended from this hill to a ravine, and then ascended the opposite ridge, upon which the trail seemed to partially give out. We therefore descended to two little ponds in the midst of a grassy spot, and waited while Bartee searched for it. As he returned unsuccessful, I encamped, and sent him again to make a thorough examination. Upon his return, he reported that the trail entirely gave out, and that the country to the west was one mass of rocks and ravines, which were apparently impassable even to Indians.

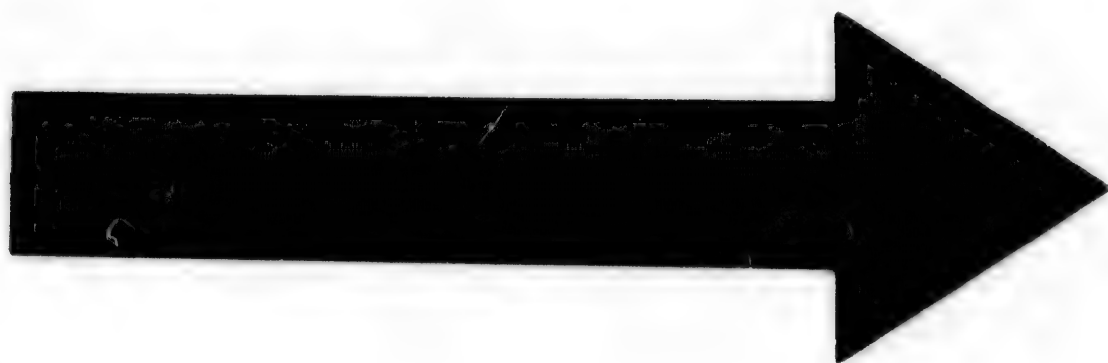
September 15.—I returned to-day to the forks of the trail, in order to try the other branch. It rained all day, sometimes quite violently, and we encamped near the forks.

September 16.—It rained furiously, and we remained in camp.

September 17.—It rained, and we did not leave camp. In the afternoon three Indians, with a squaw and horses, arrived from the south. They told us that the trail we had followed, only went a short distance. Beyond were precipices and fallen timber, which could not be crossed, and the only route in this vicinity, to the Willamette valley, was by the wagon road south of Diamond Peak. I determined to follow the left branch of the trail, and try to reach the wagon road.

September 18.—It was cloudy this morning, with every prospect of rain. While packing to continue our march, the barometer was found to be broken. As it was useless to explore





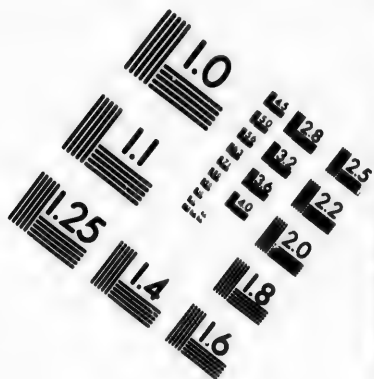
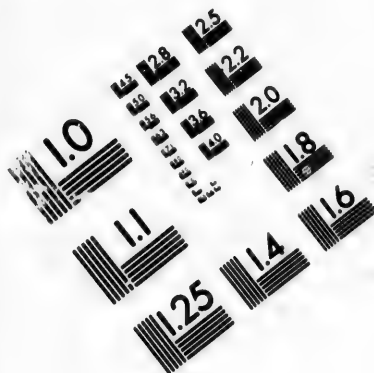
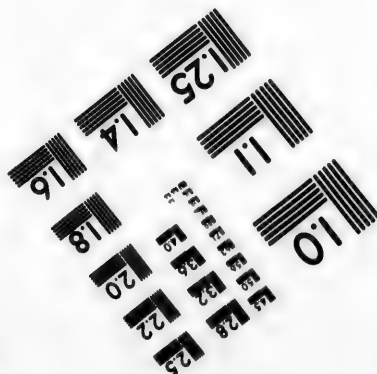
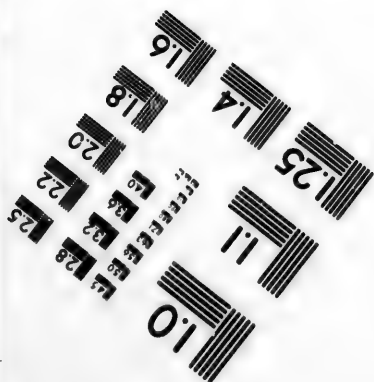
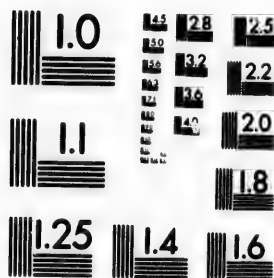


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without this instrument, I determined to return to the depot camp. We encamped at a small lake.

September 19.—We attempted this morning to shorten distance by following down Why-chus creek. Instead of taking the Indian trail. The road proved to be very bad, and nearly as long as the other. There were miry places at which we had to unpack the mules, and travelling was very slow and difficult. During our absence, Lieutenant Crook had killed a large elk.

We remained in camp until September 23, when the party arrived from Fort Dalles. They had been delayed by the necessity of sending to Vancouver for provisions. While waiting, I made many astronomical observations, for the purpose of testing the sextant.

ROUTE FROM CAMP ON WHY-CHUS CREEK, TO VANCOUVER.

September 23.—I gave Lieutenant Gibson official information that I now only required an escort, composed of Lieutenant Crook, the quartermaster and commissary of the expedition, and Lieutenant Sheridan with the dragoon detachment. After giving Lieutenant Abbot directions to explore, if possible, a route which should cross the Cascade Range, between Mount Hood and Mount Jefferson, I made every preparation for starting to-morrow myself for the wagon road south of Diamond Peak.

September 24.—I started after ten o'clock this morning, with Lieutenants Crook and Sheridan, Messrs. Fillebrown and Young, and the dragoons. We encamped where the trail crosses and leaves Why-chus creek.

September 25.—We crossed the divide of the spur from the Three Sisters, and then tried a new route, which proved to be longer and no better than the former one. We encamped near the river, just below our old Camp G.

September 26.—To-day we continued our course, and encamped near the junction of the two main forks of the second branch of the Des Chutes river.

September 27.—This morning we followed down the stream to our former Camp E. We then took a course a little south of east, and struck the south branch, probably about six miles above Camp 37. We next followed the wagon road up the river, and encamped at the place where we had crossed the first time.

September 28.—This morning we followed up the branch, which must have forked, although we saw no tributary. We did not see Camp 36, and the road for half of the distance was on the right bank. I suppose that the branch of the stream which we followed must have been a north fork. We encamped at what appeared to be a general camping place, and which proved to be the point where the road leaves the Des Chutes waters for good. A mile or two below camp, the stream apparently received a tributary from the north.

September 29.—To-day we crossed the main divide. After leaving camp we ascended a collateral ridge with a moderate slope, and followed it on an undulating trail until we ascended the main ridge, which it joined just south of Diamond Peak. North of this collateral ridge, and at its base, was a large lake, about ten miles long and two or three broad. This lake must be the source of the tributary which we saw a mile or two below this morning's camp. The summit is attainable at a moderate grade, by winding, as the hill sides appear practicable. In descending we saw to the south of us a large lake, five or six miles in diameter, which is the source of the Middle fork of the Willamette. We descended on a ridge, in many places impracticable for a railroad; but a descent could be made to the lake, by side location and winding to gain distance. Thence the route would follow down the Middle fork, possibly through a canon, and doubtless

through an immensely difficult ravine. Grass was very scarce. Several streams coming from hills north of us were crossed by the trail.

September 30.—We continued to follow the trail, and soon came to the main stream, which we crossed twelve times during the day, and half crossed twice. The road is good for a mountain road, if travelling west. This afternoon the descent was more gradual; we made a long day's march in order to obtain grass.

October 1.—We continued on the trail, which was pretty bad. It crossed the river eight times, where it was belly-deep to the mules; I noticed oak for the first time since we left Pit river, excepting a few scattered trees near Klamath lake. We marched until sunset, when, at last, we came to some poor grass. Bartee killed four deer on the way.

October 2.—In a little more than a mile from camp we came to an unoccupied house; half a mile further on we reached a residence. The grass was poor, but we encamped and purchased some oats. Several animals had broken down on the road.

October 3.—We remained in camp, and all the animals were recovered, except one dragoon horse.

October 4.—We started this morning for Spore's ferry at McKenzie's fork, leaving three privates and a corporal with the broken down horses, to rejoin Lieut. Gibson on his arrival. We found the country generally level, with a few rolling hills. McKenzie's fork was deep where we crossed, and appeared to contain much more water than the Middle fork. We encamped near Spore's house, where we purchased forage, as there was no grass in the vicinity.

October 5.—The road to-day was excellent, but greatly interrupted by fences.

October 6.—We made a good march to-day, following along the base of the foot hills. We crossed the south fork of the Santiam river, and found a beautiful valley between that and the north fork, on which we encamped.

October 7.—We encamped to-night at a house between Butte and Rock creeks. The road lay among the foot hills to-day, which were mostly timbered.

Lieut. Williamson's journal was not continued after this date. On the following day he passed through a slightly undulating, wooded region to Oregon City, where he encamped on a bluff above the town. On October 9, he proceeded to the bank of the Columbia river, through a country similar in character, and encamped opposite Fort Vancouver, where his field-work terminated. He left his party with orders to join mine on my arrival, and sailed for San Francisco himself, to make preparations for the second survey near the sources of Carson river.

THE MOUNTAIN SCENE, FROM THE MOUNTAIN HOUSE, N. H.



CHAPTER V.

NARRATIVE AND ITINERARY CONTINUED.—ROUTES OF DETACHED PARTIES IN CHARGE OF LIEUT. ABBOT.

FIRST EXPLORATION IN DES CHUTES VALLEY.—PARTY.—ACCIDENT.—QUE-Y-EN BROOK.—DRY CAÑON.—WILD VIEW.—CAÑON OF MPTO-LY-AB RIVER.—LATE ARRIVAL IN CAMP.—STRANGE CHARACTER OF THE CAÑON.—INDIAN GRAVE.—ASCENT OF CAÑON SIDE.—PEUC-SEE-QUE CREEK AND CAÑON.—CHIT-TIK-EN CREEK AND CAÑON.—WAM CHUCK CAÑON.—GOLD HUNTERS.—INDIANS.—A SURPRISE.—HOT SPRINGS.—WILD LATERAL GORGE.—CAVER.—BARIN.—MOUNTAIN.—NEE-NEE SPRINGS.—MUTTON MOUNTAINS.—TYSCH PHAIRIE.—TYSCH CREEK AND CAÑON.—FIRST SETTLEMENT.—EVELYN'S RANCHO.—POTATOES.—INDIANS.—DEAD BODY.—BREAD OF KOU'S ROOT.—WAGON ROAD.—TYSCH MOUNTAINS.—FIFTEEN MILE CREEK.—EIGHT MILE CREEK.—FIVE MILE CREEK.—FORT DALLS.—OFFICERS THERE.—CHINOOK WILLIAM AND COLONEL FREMONT'S SUPPOSED TRAIL.—DALLS OF COLUMBIA.—SALMON.—TRIP TO CASCADES OF COLUMBIA.—CAPTAIN WELLS.—MR. COB.—INDIAN BURIAL PLACE.—WIND MOUNTAINS.—SUBMERGED FOREST.—CASCADES.—BAROMETRIC OBSERVATIONS TO DETERMINE DESCENT OF RIVER.—BURIAL PLACE.—PETRIFICATIONS.—SALMON FISHING.—WILD EVENING WALK.—MEASUREMENT OF WIDTH OF COLUMBIA AT CASCADES.—RETURN TO FORT DALLS.—START TO RETURN TO DEPOT CAMP.—DIFFERENT ROUTE.—RAIN AT NIGHT.—RUMOR OF GOOD PASS TO WILLAMETTE.—LARGER HOT SPRING NEAR WAM CHUCK RIVER.—INDIANS AND SALMON IN MPTO-LY-AB CAÑON.—PAPER ON TREE.—JUNCTION WITH MAIN PARTY.—LUNAR RAINBOW AND HALO.—SECOND EXPLORATION IN DES CHUTES VALLEY AND CROSSING OF THE CASCADE MOUNTAINS.—PLAN.—PARTY.—PREPARATIONS.—DIVISION OF PARTY.—START.—TRAIL DISAPPEARS.—DIFFICULTIES.—LOVELY VIEW.—WATER BY DIGGING.—BRIGHT MOONLIGHT.—RAIN.—SURPRISE.—IMMENSE CAÑON.—VIEW.—DIFFICULT DESCENT.—PEDREGAL.—TRAVELLING ON FOOT.—CRATER.—RETURN TO RIVER.—EXAMINATION OF SECOND CAÑON.—OLD INDIAN TRAIL.—PRECIPICE.—CASTLE ROCK.—BAROMETER BROKEN.—TRAVELLING DOWN A CAÑON.—DES CHUTES CAÑON.—PLATEAU.—STRANGE HILL.—CAÑON GATE.—TRAP COLUMNS.—MOUTH OF CHIT-TIK-EN CREEK.—INDIANS.—RE-EXAMINATION OF WAM CHUCK RIVER CAÑON.—JUNCTION WITH MR. COLEMAN'S PARTY.—BAROMETER REPAIRED.—DR. NEWBERRY SICK.—TYSCH CREEK AGAIN.—INDIAN WAR.—DIRAGREABLE PREDICAMENT.—KOK-KOP.—REPORTS ABOUT PASS.—RAINY NIGHT.—INDIAN COUNCIL.—NEW GUIDE.—RETURN TO NEE-NEE SPRINGS.—START FOR WILLAMETTE VALLEY.—WIL-LA-WIT SPRINGS.—INDIAN SIGNS.—WAN-NAS-SEE CREEK.—FALLEN TIMBER.—YACUB-PAS-NEE MEADOW.—"KILL THE CART."—GREAT DIFFICULTY FROM FALLEN TIMBER.—NEW ORDER OF MARCH.—BRANCH OF TYSCH CREEK.—WAT-TUM-PA LAKE.—OO-LAL-LE BERRIER.—DELAY.—LU-AH-HUM-LU-AH PHAIRIE.—TY-TY-PA LAKE.—GAME.—MOUNT HOOD.—RAIN.—TRIANGULATION.—HORSE ABANDONED.—TRAIL DISAPPEARS.—INDIAN BLARING.—PRECIPICE.—HIGH MOUNTAIN.—EXTENDED VIEW.—MAGNETIC VARIATION.—VERY BAD TRAIL.—VIEW OF THE WILLAMETTE VALLEY.—CAÑON.—DISAPPOINTMENT.—SPRING OF WATER DISCOVERED.—STEEP DESCENT INTO ANOTHER CAÑON.—LAKE AND INDIAN "STONE HOUSE."—DIFFICULT ASCENT.—UNPLEASANT INFORMATION.—WATER AND GRASS REACHED.—RAIN.—ANXIETY.—EARLY START.—EXECRABLE TRAIL.—VIEW OF THE WILLAMETTE VALLEY.—PEDREGAL.—FALLEN TIMBER.—CAMP WITHOUT WATER OR GRASS.—MULE LOST.—SETTLEMENT.—NEWS ABOUT INDIAN WAR.—MR. CURRIE.—MULE RECOVERED BY SAM.—OREGON CITY.—LIEUT. WILLIAMSON'S PARTY.—NEWS.—LOSS OF THE ESCORT, WITH CORRESPONDENCE UPON THE SUBJECT.—EXTRACT FROM OREGON STATESMAN.—GOV. CURRY.—ROUTE FROM VANCOUVER TO FORT READING, WEST OF THE CASCADE MOUNTAINS.—START.—SALEM.—MR. GORDON.—CORVALLIS.—EUGENE CITY.—PASS THROUGH CALAPOOYA MOUNTAINS.—WINCHESTER.—INDIAN WAR AND VOLUNTEERS.—MAJOR MARTIN.—CAÑONVILLE.—DESPATCH FROM THE BATTLE FIELD.—UMPUKA CAÑON.—TRACES OF INDIAN DEVASTATION.—RETREAT.—ESCORT FROM CAPTAIN SMITH.—INDIAN DEVASTATIONS.—HEROISM OF A WOMAN.—FORT LANE.—TABLE ROCK.—VALLEY OF STEWART CREEK.—HOT SPRING.—SIEKIYOU MOUNTAINS.—KLAMATH RIVER.—YREKA.—LITTLE SCOTT'S MOUNTAINS.—FORT JONES.—LIEUT. CROOK DETAINED.—DISAPPOINTMENT.—SNOW.—SCOTT'S VALLEY.—SCOTT'S MOUNTAINS.—TRINITY VALLEY.—TRINITY MOUNTAINS.—CLAR CREEK.—FRENCH GULCH.—SHASTA.—FORT READING AGAIN AND TERMINATION OF FIELD WORK.—LIEUT. WILLIAMSON.—ORDERS FROM WAR DEPARTMENT.—SUBSEQUENT MOVEMENTS, ETC.

FIRST EXPLORATION IN DES CHUTES VALLEY.

September 6.—I left Camp 40-to-day, with instructions from Lieut. Williamson to proceed to Fort Dalls for provisions, and to examine the Des Chutes valley, north of the Three Sisters. My party consisted of Mr. Anderson, who greatly assisted me in the astronomical and barometric observations, Dr. Sterling, Mr. Coleman, and eight packers. Lieut. Gibson with Messrs. Daniel and Vinton accompanied me with a train, to procure provisions for the escort, which remained behind in Depot camp to await our return. My instruments consisted of a Gamby sextant and mercurial horizon, one of Green's cistern barometers, No. 1089, a thermometer, and a prismatic compass.

As we were about to start, a horse, becoming entangled in the cords of the office tent, threw it down and broke the barometer. I sent the rest of the party forward, and Mr. Anderson and Dr. Sterling remained with me to repair it. As this detained us about two hours, we were compelled to travel rapidly to overtake the train, already considerably in advance. Our course lay through a thick pine and fir forest. The land gradually descended for about ten miles, when we reached a fine open prairie, half a mile wide, lying at the foot of the black conical butte, which Lieut. Williamson had selected as a connecting point for our surveys. A little stream, called by the Indians Que-y-ee, trickled through the prairie, and then disappeared in a small meadow to the eastward. Fine bunch grass was very abundant in this vicinity, and it would have been an excellent camping place. After passing down the stream about a mile we left it, and, again entering the thick forest, followed for about nine miles the western base of a ridge east of the black butte. It conducted us to the dry bed of a stream. We afterwards found a little water, about two hundred yards below the place where the trail left this bed. About three miles from this point we suddenly found ourselves upon the edge of a ravine, then dry, but doubtless, in the rainy season, the bed of a mountain torrent. The banks were about 300 feet high and very steep. It was about two miles wide, and in places thickly timbered. We crossed it, and climbing up the other side soon beheld a prospect whose wild beauty I have seldom seen equalled. The sun was just setting behind the snowy peaks on our left; before us lay an immense cañon, the sides of which were rough with basalt, and heavily timbered with pine and fir. In the dim twilight, which had already settled in its bottom, we could occasionally see, between the trees, the waters of a large river, called by the Indians Mpto-ly-as. But we had no time to admire the scenery, for the train was still an unknown distance in advance. We hurried our mules as fast as possible down the rocky side of the cañon, which, by actual measurement, was subsequently found to be 1,200 feet deep. It soon became dark, and we were beginning to anticipate the pleasures of spending the night without food or blankets, when a sudden bend in the trail revealed the cheerful light of the camp fires shining before us on the river bank.

September 7.—We were encamped in a narrow part of the cañon, and as its steep sides were crowned by vertical walls of columnar basalt, it would have been impossible for a pack mule to get out of it, in most places. There was but little grass near camp. As a plain although very bad Indian trail led out of the cañon on the south side, we followed it for about three miles, hoping that it might lead to a better ford; but finding that it turned to the south, we returned to our camp; crossed the river, which is a rushing torrent that swept away and nearly drowned one of the mules; and then followed down the cañon, trying to find a place where we could ascend its northern side. This river cañon is very remarkable. Its sides vary from 800 to 2,000 feet in height. The river has cut down its bed to this immense depth through successive strata of basalt, with occasionally a deposit of infusorial marl and volcanic tufa, which has sometimes hardened into a kind of conglomerate sandstone, ten or twenty feet in thickness, and of a white, gray, or reddish color. Often, as the banks have gradually receded, a slender column of this deposit, capped by a huge piece of basalt protecting it from the weather, has been left projecting high above the mass of detritus around it, its sides washed smooth and often worn into fanciful forms by the rains of ages. It required but little imagination to see, in these light colored figures, giants and monsters guarding the dark, frowning sides of the cañon. The entire absence of all signs of life, the dull sound of the river rushing over its rocky bed, and the dark green of the stunted cedars and pines, clinging to the precipices which confined it,

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united with these wild unearthly figures to give a gloomy desolation to the scene, which was not a little heightened by a solitary Indian grave. It was marked by a pile of stones, a short stick with a piece of white cloth attached to it, and the skeleton of a horse, shot upon the last resting place of his master.

We followed down this cañon for about five miles, when a rocky spur cut off all further progress, and compelled us to attempt the ascent. This, with great difficulty, we accomplished, and found ourselves on a plain, thinly dotted with sage bushes and clumps of grass. We continued our course, and, after crossing the bed of a torrent of the rainy season, came to a very small stream called Psuc-see-que by the Indians. It was sunk in a cañon about 500 feet deep, cut through successive strata of basalt, infusorial marl, tufas, and conglomerate sandstone like that found in the Mpto-ly-as cañon. There was a little grass in the narrow bottom and on the sides, and some small cedars, willows, and bushes near the water's edge. Here we encamped, after a laborious day's march, which had brought us but very little nearer the end of our journey. The view from our camp was wild and beautiful. Looking up the cañon, we could see the snowy summit of Mount Jefferson closing the narrow vista; while the steep banks, with their strongly contrasting colors of black, white, blue, pink, and red, gradually approached each other below our camp, until they formed a narrow gateway, through which we had a glimpse of a little opening in the ravine beyond.

September 8.—This morning our course lay through a lateral defile, opening out of the Psuc-see-que cañon by a narrow gate, about half way up its northern side. The general character of the country was similar to that through which we passed yesterday. In about six miles we reached a fine stream called Chit-tike, which was sunk in an enormous cañon, 900 feet deep, very much resembling that of the Psuc-see-que, except that it had a wider bottom and more bushes on the water's edge. The grass in the bottom was coarse and not very nutritious; but on the sides there was a little excellent bunch grass, as is generally the case in these river cañons. We crossed it and entered a narrow gorge which led into a valley, about two miles wide, nearly parallel to the cañon that we had left, and covered with scattered sage bushes and a few stunted cedars. This we crossed, ascended by a steep rise into a small basin surrounded by hills and considerably elevated above the valley, climbed another steep hill, and found ourselves on the summit of the northern divide of Chit-tike creek. Before us lay a gradual descent, appearing to reach to the foot of a low ridge, which, after extending in an east and west direction about ten miles, abruptly terminated at each extremity. Portions of the sides of this range were of a brick red color, which gave it a strange appearance at a distance. As we approached, we found that a cañon 300 feet deep, with steep sides of basaltic rock and red earth, separated us from the foot of the range. It contained a stream of considerable size, called Wam Chuck. In the cañon we were much surprised to see a party of twenty or thirty white men, who were vainly searching for gold. They had started to explore this barren region, in the hope of discovering new mines; but, as yet, had met with no success. There were also several Indians, who crowded around us with great surprise and interest. They were delighted beyond measure at a ludicrous accident which happened to one of our party; who, being very thirsty, and seeing a beautiful, clear spring bubbling from under a rock near the trail, jumped from his mule, and lying on the ground eagerly filled his mouth with the tempting liquid. He instantly ejected it, however, with looks of wild astonishment, and many grimaces indicative of anything but satisfaction. It was a hot spring with a temperature of 140° Fah.

Wam Chuck river flows with a rapid current over a bed of large rounded rocks, which render

the ford a little difficult. There are a few stunted cedars in the cañon, but very little grass where the trail crosses it. Its banks are often very precipitous, and composed of basaltic rock, and earth of various reddish shades. The water of the river is clear and cold; and it derives its name, Wam Chuck or Mil-lil-le Chuck, signifying warm water, from several hot springs upon its banks. Some of them give off an odor of chlorine, and are partly covered with a thick green scum containing soluble silica. Others seem perfectly clear and pure. The former class is generally bordered by a white solid deposit from the water. Large rocks in the vicinity are sometimes incrustated with the same substance. The springs often contain cooked grasshoppers, bugs, and snakes, that have unwittingly taken a warm bath.

The trail leaves the cañon by a narrow lateral gorge, with sides in many places vertical or even overhanging, and from one to three hundred feet in height. There are large caverns high up in these cliffs, to which access without ropes would be impossible. The pass is a vast, narrow gateway, whose wild beauty defies description. It preserves this character for about a mile, and then suddenly expands into a little basin surrounded by low mountains, and abounding in very interesting varieties of silicious rock. This basin contains good grass and a spring of pure water, thus forming a better camping place than the river cañon. We crossed it, and toiling up a rocky mountain, until we gained an elevation above the basin of about 1,600 feet, wound round its eastern side near the edge of a deep ravine, into which, in many places, a single mis-step would have precipitated us. After gaining the northern side, we passed over low, rolling hills for about two miles, and then crossed the dry bed of a stream in a small ravine. Passing over an elevated country for about three miles, we next came to a place where there were a few small water holes, apparently excavated by the Indians. About two miles beyond was a very small stream called Nee-nee, or Willow springs. Here we encamped under a few fine trees. There was an abundance of good bunch grass, and our animals fared better than they had since we left the main party. The Indians fully appreciate the excellence of this kind of grass for their horses, and Nee-nee is one of their favorite resorts. We found near camp a large deposit of fine red and white sandstone, which was beautifully stratified.

September 9.—After riding this morning among low, rolling hills for about two miles, we reached another moist spot called by the Indians Hy-as Nee-nee, or Great Willow spring. Here the trail forks. We took the right hand branch, which led us, by an ascent of about 200 feet, to the northern border of the elevated spur upon which we had been travelling since we left Wam Chuck cañon, and which is named, by the white traders, the Mutton mountains. About 1,900 feet below us lay a sterile, treeless, basaltic plain, elevated 2,200 feet above the sea. It is called Tysch prairie. The thickly timbered foot hills of the Cascade Range marked its western border. About thirteen miles north of where we stood, a smooth ridge, yellow with dried grass and unmarked by a single tree, rose abruptly; and, after extending about thirteen miles in an eastern and western direction, suddenly terminated at each extremity. To the eastward, beyond the enormous cañon of the Des Chutes river, which we could distinctly trace, the plain became broken by rolling hills, extending as far as the eye could reach. The descent to the prairie was very steep, and we afterwards found that the left branch of the trail at Hy-as Nee-nee, was much the better of the two; since it followed the gradual slope of a ravine, and joined the other soon after gaining the prairie. This ravine, although entirely dry in the summer, is, in the rainy season, the bed of a torrent, whose rocky course, near the base of the Mutton mountains, we found bordered by stunted oaks, the first we had seen for many miles. After



MOUNT HOOD FROM TYSCH PRAIRIE

crossing Tysch prairie we reached the edge of the deep cañon of a creek of the same name, which washes the base of the spur forming its northern boundary. We crossed the stream a short distance above the junction of two branches, the first of which was turbid with sand, but the second clear and pure. Both fords were good. There was considerable grass on the sides of this cañon, and a narrow strip of good land in the bottom, and we saw before us, with a feeling of strange pleasure, a settler's log cabin and a fenced field. This rancho, together with a ferry across the Des Chutes river, near the mouth of Tysch creek, belonged to Mr. Evelyn, formerly of Cleveland, Ohio, who treated us with great kindness, both at this time and subsequently. We encamped on the creek, and feasted sumptuously on some fine potatoes, which were fully appreciated, as the want of fresh vegetables had begun to cause scurvy among the party.

There was, near our camp, a large rancheria of Indians, among whom a disease resembling the cholera had been raging. About thirty had recently died; and, in accordance with their customs, the relations of the deceased spent their nights among the rocks of the cañon sides, shrieking and howling in lamentation. These sounds, now near, and now remote, were very mournful and impressive as we lay around our camp fire. We felt less sympathy for their affliction, because one of our party, who had found a dead body lying in the bushes near us, had been told rather disdainfully by an Indian to whom he pointed it out, that it was only a prisoner, not worth burying. The ground near the rancheria was strewn with *kous*, a root from which they make a kind of very hard bread called "sup-pal-le." It had belonged to their dead, and had, on this account, been thrown away as ill-omened.

September 10.—The trail this morning followed up the creek a short distance, and entered a wagon road leading from the Dalles to the Willamette valley. It is very mountainous, and bad for wagons. We had a good specimen of its character while toiling up the range of low trap mountains north of Tysch creek, where the road gained an elevation of about 1,500 feet above the stream, by an ascent in many places so steep, that it was difficult to conceive of heavily loaded wagons passing up or down. After reaching the summit, our course lay over a gently undulating country covered with bunch grass. About ten miles from camp we crossed a small, dry ravine. In about seven miles more we entered, by a lateral defile, a fine open valley, containing several ranchos on the banks of a small, clear stream, called Fifteen Mile creek. The road now became very hilly. Between four and five miles further on, we crossed another stream, called Eight Mile creek; and in two miles more, another, called Five Mile creek. Two miles more brought us to a beautiful valley, and on climbing the hills beyond, a noble panorama burst upon our view. The grand snow peaks of Mount Adams and Mount Hood, connected by dark fir-covered ridges, formed the background. In the distance, the broad Columbia wound through a terraced valley, and disappeared among the mountain gorges; while in the foreground, our national flag waving over the little town of the Dalles showed us that the wished for goal was won.

The fort is pleasantly situated on a small creek, about a mile south of the town, and is considerably elevated above it. We were received with great kindness by Major Haller, Captain Auger, Lieutenants Forsythe, Macfeely, and Dearing, of the 4th infantry, and Dr. Hammond, the officers then stationed at the post. Everything which could contribute to our comfort was thoughtfully supplied during our stay. I am also indebted to Major Haller for giving me much valuable topographical information about the country in the vicinity of the Dalles.

While waiting for provisions from Vancouver, I had an interview with William, a Chinook

Indian whom Colonel Frémont carried, in 1843, to the eastern States to be educated. I asked him very particularly about a summer trail up the Des Chutes valley, which Colonel Frémont was informed lay nearer the Cascade mountains than the one he followed. The Indian assured me that there was no such trail, and that, "if I wanted to take my pack mules through that region, I must go first with pick and shovel and make a trail, and then return for the animals." Although I questioned many white men and Indians about this trail, I could never find one that had even heard of it, and I am satisfied, from my own subsequent explorations, that none such exists. Colonel Frémont was, undoubtedly, misled by false reports; and the trail seen by him on December 4, 1843, probably terminated, like many which disappointed us in the same vicinity, in a whortleberry patch.

At the Dalles of the Columbia, situated a short distance above the town, the river rushes through a chasm only about 200 feet wide, with vertical basaltic sides rising from 20 to 30 feet above the water. Steep hills closely border the chasm, leaving, in some places, scarcely room on the terrace to pass on horseback. The water rushes through this basaltic trough with such violence, that it is always dangerous, and in some stages of the water impossible, for a boat to pass down. The contraction of the river bed extends for about three miles. Near the lower end of it, the channel divides into several sluices and then gradually becomes broader, until, near the town where it makes a great bend to the south, it is over a quarter of a mile in width. The Dalles is a favorite fishing resort for the Indians; and we saw, on the river bank, many piles of salmon which they had preserved for winter use. There are many fine specimens of columnar basalt in this vicinity, and the banks rise in low basaltic terraces, which, on the northern side opposite the town, are very rough and broken.

Our provisions arrived from Vancouver on September 16, and my men immediately began to prepare them for transportation on the pack mules.

September 17.—To-day I went, by steamboat, to make a rough reconnaissance of the river as far down as the Cascades, and to determine its descent there, leaving orders with Mr. Coleman to start for the Depot camp as soon as the provisions were ready. A small steamboat runs from the Dalles to the Cascades, where there is a land portage four miles and a half in length. From its lower terminus, another steamboat runs to Vancouver, and thence to Portland in the Willamette valley. I feel under great obligations to Captain W. B. Wells, the chief proprietor of this line of steamboats, and to Mr. L. W. Coe, an artist by profession, but now connected with the company, for their personal kindness, and for the valuable topographical information which they furnished.

In passing down the Columbia from the Dalles, the natural scenery was of the most magnificent description. The river soon entered a gorge of the Cascade Range, and wound through a wilderness of mountains, whose silent grandeur was truly impressive. In about ten miles we passed the narrow entrance of the cañon of Klik-a-tat river, a mountain stream flowing from the north. Soon afterwards we passed the Mam-a-loos islands, the lonely resting place of a departed nation of red men, whose bones lay bleaching in the sun. The method of burial had been very simple. Four stakes, interlaced with twigs and covered with brush, formed a tomb, which had been gradually filled with dead bodies, and then abandoned to the wind and rain. Ten miles more brought us to Dog River valley, a little, fertile spot extending towards Mount Hood, and forming a pleasing contrast to the savage mountains by which it was bordered. Nearly opposite was the mouth of White Salmon river, which struggled through a narrow gorge opening towards Mount Adams. About ten miles further on, we passed on the northern bank Wind mountain, a round isolated

peak so steep that to ascend it from the river side would probably be impossible. Near its base is the mouth of a small stream called Wind river, which appeared to be formed by the junction of two branches behind the mountain. On the opposite bank the ridges, rising very abruptly from the river, seemed to be formed of loose stones, which would render excavation for a road very difficult and dangerous.

It is in this vicinity that the celebrated submerged forests are mostly found. They consist of numerous dead trees, stripped of their smaller branches, but still standing upright in the deep water near the river banks, and presenting every appearance of having grown there. As these trees could never have grown under water, their present position has given rise to much speculation. It has been suggested that they may have been transplanted from the neighboring mountains by vast avalanches. It is possible that this may be true in a few places, but not in all, as they are sometimes found where the position of the mountains precludes the idea. Another theory, which I think much more plausible, is, that formerly a great slide occurred at the Cascades, about fifteen miles below Wind mountain, and formed a dam; which, by raising the water above it, submerged and killed the forests growing on the banks. The appearance of the Cascades tends to confirm this idea. For four miles and a half the river rushes through a gorge, bordered by high and very precipitous ridges, and only about nine hundred feet wide in the narrowest part. Above, it expands into a kind of lake, about a mile and a half in width, containing several islands.

We reached the landing above the Cascades early in the afternoon, and were much pleased to find that it was not raining there, as it very often does in September. I took a careful reading of the barometer at the water's edge near the landing, and another at the foot of the principal rapid, about a quarter of a mile below; subsequent calculations give a difference of level of 34 feet between these stations. I then walked with Captain Wells to the lower landing, about four miles and a half from where we first went on shore, and took a third reading; from which the total descent in that distance was afterwards found by computation to be 61 feet. During high water the portage is much shortened, as the boats can ascend nearly to the foot of the principal rapid.

The wild grandeur of this place, for which Rapids would be a more appropriate name than Cascades, surpasses description. The river rushes furiously over a narrow bed filled with boulders and bordered by mountains, which echo back the roar of the waters. The path, winding through a thick forest on the northern bank, suddenly crosses an Indian burial place, where whitened bones strew the ground on every side, and fill one with amazement at the vast numbers of the dead. Petrifications are abundant; and stumps closely resembling those of trees recently cut, are often found to be solid rock, with bark and woody fibre perfectly preserved. Salmon pass up the river in great numbers; and the Cascades, at certain seasons of the year, are a favorite fishing resort with the Indians, who build slight stagings over the water's edge, and spear the fish, or catch them in rude dip nets, as they slowly force their way up against the current. I passed through a rancheria of these savages, on my return in the evening from the lower landing. Their hideous faces, strongly painted on the darkness behind them by the flickering light of the fire around which they were crouching, and their mournful howls blended with the baying of their dogs at my intrusion, harmonized well with the ceaseless roar of the river, and the gloom of the forest cemetery, among the dry bones of which I turned to grope my way.

September 18.—This morning I returned by steamboat to Fort Dalles, after measuring the width of the river, by triangulation, in two places near the principal rapid. It proved to

be 967 feet in one place, and 1,811 feet in the other. As my train had already started for the depot camp, I settled all accounts, and made every preparation for following it on the next morning. Dr. Sterling here left the party.

September 19.—Starting alone this morning to overtake the train, I travelled over the same road as in coming, as far as Fifteen Mile creek, and then followed a pack trail up a long and gently sloping ravine. In about 10 miles it conducted to the wagon road again, 3 miles from Tysch mountains. By a little side cutting, a road could be made in this ravine, shorter and better than the one at present used. I overtook my party at Tysch creek, and encamped there. We slept, as usual, without tents, and a shower in the middle of the night gave us an unpleasant surprise. It was but a poor consolation to reflect that they might now be expected at any time, as the rainy season had commenced.

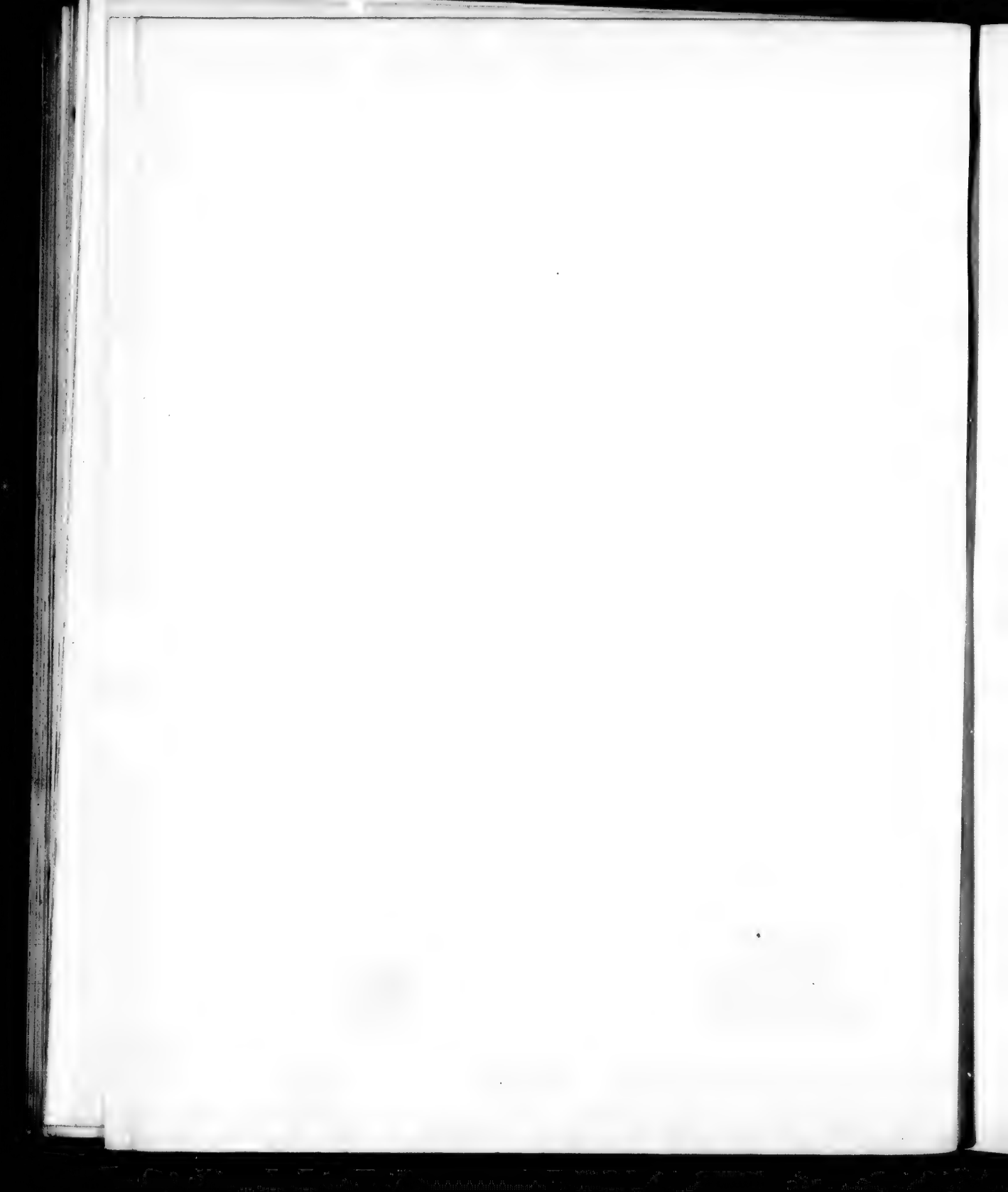
September 20.—This morning a half-breed informed me that there was a good pass to the Willamette valley, through a slight visible depression in the mountains near Mount Hood. This information had an important effect upon our future movements. To-day we continued our journey back over the trail by which we had come, and encamped at Nee-nee springs.

September 21.—At Wam Chuck river I examined a warm spring larger than any I had seen before. The great flat rock through which it rose, seemed unstable, for stepping on it caused the water to bubble up more freely. The spring seemed to flow from a number of small holes in a place 15 or 20 feet in diameter, and its temperature was 145° Fahrenheit. It was on the northern bank of the river, about a quarter of a mile above the point where the trail crossed. Access to it was rather difficult, on account of the narrow character of the cañon, but it well repaid the trouble of a visit. We encamped on Chit-tike creek.

September 22.—To day we encamped, at the same place as before, in the Mpto-ly-as river cañon. Here we met a party of Indians, with their squaws and children, travelling north. They caught several salmon in the river; one of which, weighing about twenty-five pounds, we bought. They spear the fish with barbed iron points, fitted loosely by sockets to the end of poles about eight feet long. When the point pierces the fish, it separates from the end of the pole, but remains strongly secured to it by a thong about twelve feet in length. This prevents the salmon from breaking the pole in his struggles. A member of our party shot with a pistol and secured one of these fish, of which there were many in the river. Our animals suffered from want of grass to-night.

September 23.—To day we followed the old trail to the "black butte," where we found a paper on one of the trees, stating that the main party was in camp on Why-chus creek, about seven miles towards the south. We struck through the woods, and soon saw the white tents in an open prairie covered with grass and bordered by fine timber. Near it, the brook Que-y-ee, after spreading out into a meadow, disappeared. This little opening, amid forest-clad mountains and grand snow peaks, furnished a camping place, the wild beauty of which I have seldom seen equalled. This was enhanced, in the evening, by a magnificent lunar rainbow, and a beautifully tinted halo round the moon; both of which appeared at the same time in different quarters of the heavens. It is a singular coincidence that Col. Frémont, the only explorer who ever preceded us in this region, saw the same rare phenomenon of a lunar rainbow, within about twenty miles of this spot, in 1843.





SECOND EXPLORATION IN DES CHUTES VALLEY, AND CROSSING OF THE CASCADE MOUNTAINS.

September 24.—The party again separated at Camp S on Why-chus creek. Lieut. Williamson dispensed with the future services of all the escort, except Lieut. Sheridan, with his dragoon detachment of twenty-five men, and Lieut. Crook, the quartermaster and commissary of the expedition. Accompanied by this small party, with Messrs. Fillebrown, Young, Bartee, and three packers, he started to cross the mountains near Diamond Peak, and follow down the Willamette valley to Vancouver. Lieut. Gibson, with the rest of the escort, started for Fort Lane. Dr. Newberry, Mr. Anderson, Mr. Coleman, and fourteen packers, with all the spare animals and most of the baggage, remained with me in camp. My orders were to explore the mountains to the north; cross them where I best could; and rejoin Lieut. Williamson at Vancouver. Not anticipating any Indian troubles, we considered my party sufficiently strong for this purpose. The day was spent in recruiting the animals, and in repairing a broken barometer.

September 25.—In the morning we travelled about eight miles towards the base of the "black butte," and encamping on Que-y-ee brook, near where we had crossed it in going to the Dalles, spent the rest of the day in completing our arrangements. I had already seen that no railroad could be built in the valley near the Des Chutes river. It now remained to explore the region near the eastern base of the foot hills. Having about eighty animals, many of which were almost broken down, I decided to divide my command, and examine the unknown region with a light scouting party, while Mr. Coleman, in charge of the rest of the train, should return by our former trail to Nee-nee springs, and recruit the animals on the excellent bunch grass there, until I should join him.

The brook Que-y-ee, near camp, was clear and cold, but rendered difficult of access by thick bushes, and in some places by miry banks. There was plenty of bunch grass in the vicinity, but the dense forest which surrounded us rendered the loss of animals probable.

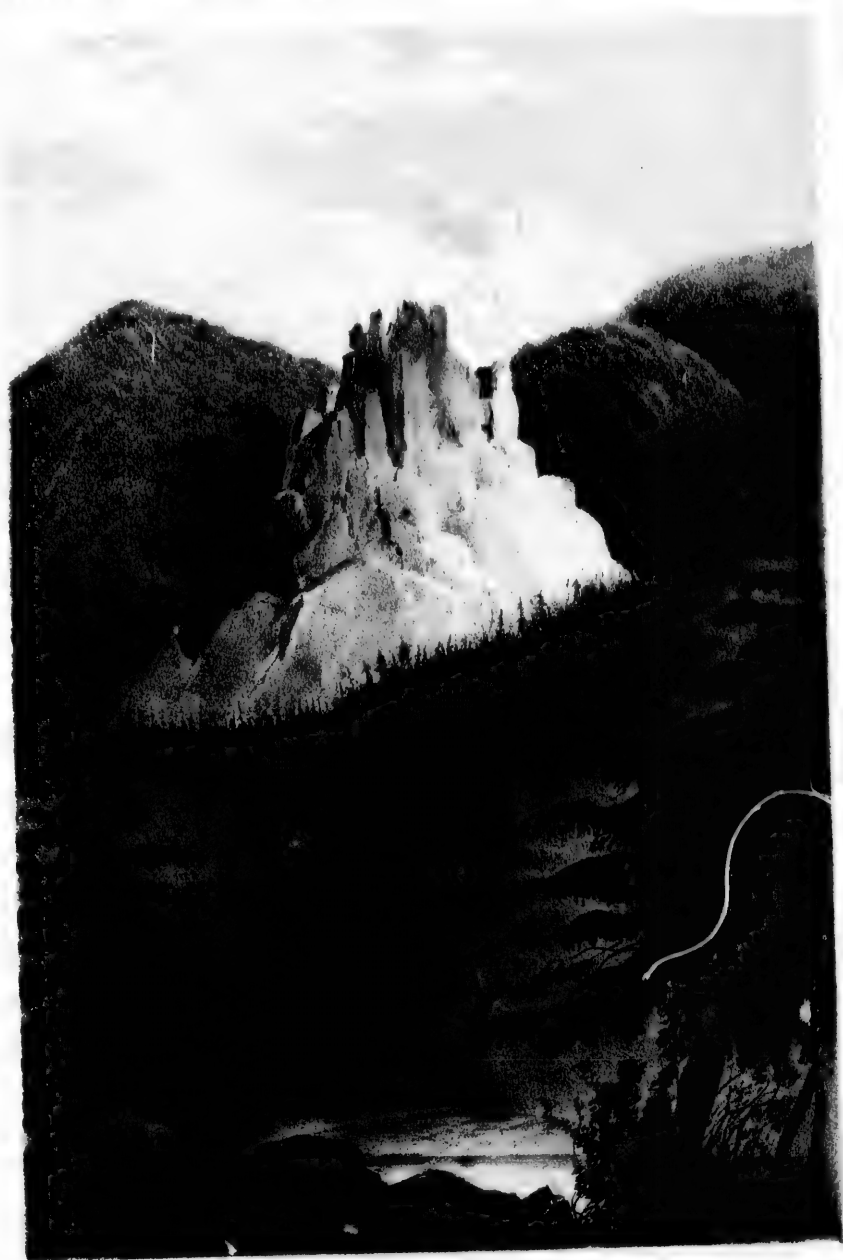
September 26.—This morning we separated. My little party consisted of Mr. Anderson, Dr. Newberry, myself and eight men. We took eleven days' provisions, and twelve pack mules loaded with only seventy-five pounds each, as I anticipated many difficulties on our unknown route. We followed our old trail to the point where it forked, about nine miles from camp, hoping that the western branch might lead to the foot hills; but it almost immediately terminated in an old Indian rancheria, near which there was a little water in the bed of the creek that we had found dry at the fork. Disappointed in the trail, I endeavored to take a northwest course by compass. The pine forest was very thick; the pumice-stone soil was so light that our mules sank over the fetlock at every step; and the fallen timber and thick underbrush continually obstructed our way. We toiled slowly up a long, gradual ascent, now turning to the right and now to the left to avoid the fallen timber, until we were forced, by some impenetrable underbrush, into a slight ravine, in which were a few pools of water. Fighting our way with great difficulty among the logs which filled the bottom, we climbed its northern side, and entered a small open space dotted with a few clumps of grass. The men were directed to herd the jaded animals in this breathing spot, while Dr. Newberry and I crawled over the dead trees into another ravine, northeast of us, to search for water. Finding none, we all struggled on towards the west, fully expecting, as the sun was low, to encamp in the forest without water or grass. Before halting, however, we suddenly reached the summit of a slight precipice; at our feet lay a fine little prairie, about a quarter of a mile long, covered with the richest bunch grass, and bordered on

every side by thick forests of pine and fir. Beyond it, the sun, which had nearly set behind Mount Jefferson, crowned his snowy head with crimson and gold, and threw an indescribable glory over the tangled mass of mountains at his feet. We descended, and began eagerly to search for water; but found none. Still, as it was too late to go further, we encamped; and, by digging a hole about three feet deep in a moist spot, succeeded in obtaining enough muddy water for ourselves, but not for the animals. The little prairie was evidently, in the rainy season, a meadow in which a tributary of Mpto-ly-as river heads. Mr. Anderson in following down its bed through the forest found a little water, about a quarter of a mile from camp; but it was dark before he returned. The moon seemed very bright in the pure mountain air, and I easily wrote my journal by its light.

September 27.—This morning it rained. After following a westerly course through the wet bushes for about a quarter of a mile, we suddenly saw the light breaking through the dense forest before us, and, hoping that we were approaching another prairie, pressed eagerly forward. We soon stopped in blank amazement on the verge of an immense cañon, which was found by subsequent measurement to be 1,945 feet deep. Far below us we heard the roar of a mountain torrent. Opposite rose, steep and black, and hitherto unseen by civilized man, the naked base of Mount Jefferson, while around it clustered gloomy, fir-covered mountains, whose tops were hidden in rolling masses of clouds. The cañon side below us was so steep and rocky that we feared the descent would be impracticable. I directed the animals to be herded, and sent three men to explore it, while Dr. Newberry and I followed along the edge about half a mile to a projecting cliff, from which we could obtain a better view of the country. It had ceased raining, and the heavy clouds which shrouded the opposite mountains rose slowly until a noble panorama lay outspread before us. The river came from the south in an enormous cañon, and, after washing the base of Mount Jefferson, disappeared in a northerly direction. Into this cañon two others opened in front of us, one containing a small tributary from the west, the other winding out of sight towards the north, apparently in the direction which we wished to explore. The bottom of the latter appeared to be free from trees, and to rise with a very gentle slope. Much elated by the prospect of escaping from fallen timber, we returned to the rest of the party, and began the descent to the river. Slowly and with great difficulty we forced our animals, now along narrow ledges of dark gray slate, where a mis-step would have precipitated them to instant destruction, now down steep slopes of loose rocks of the same character, masses of which, becoming dislodged, rolled down the precipice, and starting others in their course filled the cañon with reverberating echoes. After winding about in this manner for nearly three quarters of a mile, we at length reached the bottom in safety. It was about three hundred yards wide, bordered by pines and thickly carpeted with fine bunch grass. A river, which I knew must be the Mpto-ly-as, flowed through it, apparently unfordable from its depth and velocity. Its banks were abrupt and lined with willows, and its bed was full of boulders. After riding up the cañon about a half a mile, we at length discovered a very bad rocky ford, but some of the animals mired in getting out of the water. We then turned towards the north, and crossing the western cañon near its mouth, found in it a small stream with very miry banks, and an old Indian trail. On reaching the second lateral cañon we found, to our bitter disappointment, that the absence of trees in its bottom was due to a mass of comparatively modern lava, divided in every direction by deep fissures, which rendered it totally impassable to our animals, and almost so to ourselves. It had flowed from the eastern side of Mount Jefferson, and had cooled so rapidly as to leave a narrow strip of the valley, on each side,

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VIEW OF MOUNT HOOD IN GORGE OF MOUNTAIN RIVER NEAR CAMP 137.

uncovered. These strips were about ten feet lower than the surface of the lava field, and densely filled with firs and pines. Ice-cold brooks, from the melting snow on Mount Jefferson, washed the edges of the pedregal, and occasionally spread into narrow swamps extending to the steep sides of the cañon, and completely choked with bushes. Hoping to be able to force our way through these obstacles, we struggled desperately up the southwestern edge for about three miles. A projecting spur here closed in abruptly upon the lava, and rendered further advance impossible. Leaving the rest of the party with the jaded animals, I crossed the stream on a natural bridge formed of an old log, climbed up the side of the lava field, and sometimes leaping over yawning fissures, sometimes winding around them, gradually advanced about a quarter of a mile to what appeared to be a small crater. It was nearly circular in form, and about two hundred yards in diameter, with the lower side partly broken away. A more utterly desolate spot cannot be conceived. No sign of life was visible. Rough masses of dark lava lay piled around like the waves of a stormy sea. Fir-clad mountains reared their inaccessible summits on every side, apparently cutting off retreat; while Mount Jefferson, without one intervening ridge, towered high above all, rugged with precipices and capped with glittering snow. It was a spot where, in all probability, no human foot had ever before intruded, for even the wild children of the forest abandon it to the fiends and demons of their traditions.

A high ridge from Mount Jefferson terminated the cañon, and rendered further exploration unnecessary, as well as impossible. I returned to the party, and we retraced our steps to the little stream flowing from the westerly cañon, and encamped there, with an abundance of fine grass and ice-cold water.

September 28.—Being unwilling to leave without examination the western cañon, where we had seen the Indian trail, Mr. Anderson and myself, with two men, started to explore it this morning, leaving the rest of the party in camp. We soon struck the trail, and followed it for about four miles up a little wooded gorge, which gradually turned towards the south.

Here we found that our "black butte" was in sight, and that the trail apparently led to the prairies near it, through a straight and level valley. We accordingly turned back, fully satisfied that the only way of advancing to the north was to travel down the Mpto-ly-as cañon. On breaking up camp we followed the old trail, which took this course. It led us below the lava field, across the two brooks which had flowed by its sides, and then up a long, gentle slope, through an open forest of pine, larch, and fir. We were beginning to congratulate ourselves on the excellence of the trail, when, about six miles from camp, we were suddenly stopped by another precipice bordering the river, and more than 1,000 feet deep by measurement. From the summit, I could see that the ridge, which I had already observed extending from Mount Jefferson to a black peak, continued beyond it, and, without any marked depression, now formed the north side of the river cañon, which began to turn towards the east. With much difficulty gaining the river bottom, which was here filled with a tangled mass of small trees and bushes, we toiled on for about three miles further, and then encamped in a narrow strip of fine bunch grass. Both sides of the cañon were here about 1,500 feet high; and opposite us, some 800 feet above the water, was a large mass of gray conglomerate sandstone, so much resembling the ruins of an old castle that we could hardly believe it the work of nature. It rose abruptly from the dark foliage around it, with its battlements, turrets, and towers, bathed in the light of the setting sun—a fitting home for the presiding genius of this wild torrent of the mountains.

September 29.—After travelling a few miles down the cañon to-day, the barometer began to leak badly from a crack in the glass cistern. As all the materials for properly repairing it were

with Mr. Coleman, I decided, rather than to run the risk of ruining it by transporting it in its present condition, to remove the mercury, and replace it after rejoining him.

Abandoning, therefore, my intention of leaving the river as soon as possible and further exploring for a railroad pass near the mountains, which the loss of the barometer rendered inexpedient, I followed down the cañon about eleven miles, to where we had crossed it in going to the Dalles. The trail was rendered execrable by numerous steep spurs, which ran out to the very water's edge, and compelled us to toil up sometimes as high as 500 feet, and then abruptly descend again. We began to find concretes and tufas on the sides of the cañon as we approached our old camping place; but there was none of this formation near Mount Jefferson. At one place there were a few rude pictures of men and animals scratched on the rocks by some wandering savage. On the march to-day we shot and secured one of the fine salmon which abound in the river, and which are highly prized by the Indians for winter food. Three streams, flowing in deep cañons, entered the river from the north. One of them showed, by the milky color of its water, that it came from the melting snows of Mount Jefferson, and thus proved that the country between us and Chit-tike creek was furrowed by at least one enormous ravine, which could not be headed. After reaching our old trail, we followed it to Psuc-see-que creek, and encamped there after sunset; having travelled twenty-one miles to-day over a most difficult route.

September 30.—As it was highly desirable to determine accurately the position and character of the cañon of the Des Chutes river, I started this morning, with one man, to follow down the creek to its mouth, leaving the rest of the party in camp. Having yesterday experienced the pleasures of travelling in the bottom of a cañon, I concluded to-day to try the northern bluff. It was a dry, barren plain, gravelly and sometimes sandy, with a few bunches of grass scattered here and there. Tracks of antelopes or deer were numerous. After crossing one small ravine, and riding about five miles from camp, we found ourselves on the edge of the vast cañon of the river, which, far below us, was rushing through a narrow trough of basalt, slightly resembling the Dalles of the Columbia. We estimated the depth of the cañon at 1,000 feet, but I think it would be found to be deeper, if measured. On each side, the precipices were very steep, and marked, in many places, by horizontal lines of vertical basaltic columns fifty or sixty feet in height. The man who was with me rolled a large rock, shaped like a gripstone and weighing about 200 pounds, from the summit. It thundered down, for at least a quarter of a mile, now over a vertical precipice, now over a steep mass of detritus, until, at length, it plunged into the river with a hollow roar, which echoed and re-echoed through the gorge for miles. By ascending a slight hill which rose from the plain, I obtained a fine view of the surrounding country, and many valuable bearings to the mountain peaks. The generally level character of the great basaltic table land around us was very manifest from this point, although, near the trail, it is marked by a continual succession of deep ravines. Bounded on the west by the Cascade mountains, and on the north and east by the Mutton mountains, the plain extends far towards the south, a sterile, treeless waste. At the mouth of the Psuc-see-que cañon there is a singular hill isolated from the plain. Its top is a nearly circular floor of basalt, surrounded by vertical precipices about forty or fifty feet deep, and then by a collection of detritus, sloping down at an angle of about 45° to the level of the river.

In returning to the camp, we tried the cañon of the creek, which we found very narrow and stony, and often so obstructed by bushes as to compel us to climb along its steep sides. About a mile below camp it narrowed into a wild, natural gateway, the top of which, elevated about 500 feet above the creek, was formed of two vertical precipices of columnar basalt, each about

100 feet deep, and separated 800 feet from the other. From these precipices, piles of detritus sloped down at an angle of 45° to the little silver thread of water winding between them. The huge rocks in the bottom compelled us to climb about half way up this slope to effect a passage. The line of columns on the top of the northern side was strangely bent and distorted, as if, while they were in a semi-fluid state, a huge crag had fallen among them; those on the southern bank were very straight and vertical.

We travelled to-day to Chit-tike creek, and encamped there. Dr. Newberry and I followed its bed, on foot, about two and a half miles, to the Des Chutes river. We found it a deep, swift stream, 80 yards wide, and still sunk in the enormous cañon, which, I have no doubt, extends about 140 miles above its mouth. The Chit-tike cañon is much wider than that of Pasc-see-que, and there is a good trail leading to the river in its bottom. It was dark before we rejoined the party; and the camp fires, shining among the bushes, formed a striking contrast to the gloom of the cañon as we approached.

October 1.—On reaching Wam-Chuck river this morning, we found a large number of Indians encamped there, who were very desirous to trade potatoes for matches and ammunition. Sending the party forward to join Mr. Coleman at Nee-nee, Dr. Newberry and I stopped to examine more fully this most interesting locality. Had we known that these savages were on the point of joining in a general war against the whites, we might have felt less curiosity. As it was, we visited the warm spring, which I had seen on September 21; examined the lateral gate cañon; collected several interesting geological specimens; and then climbing to the summit of the mountains, round the eastern side of which the trail winds, obtained a very extensive view of this strange, picturesque valley. The great number of compass bearings that I took from this and many other commanding points, cover the whole region with a net work of triangles, which, I think, cannot fail to render the accompanying map of this section quite accurate.

We reached Nee-nee springs a little while before sunset, and found Mr. Coleman and his party awaiting us. He had met with no difficulty, except in transporting the battered pair of wheels to which our odometer was attached, and which, out of compliment to its former estate, still retained the name of the "little cart." Much credit is certainly due to him, considering the small number of his party, for getting even this up and down some of the precipitous cañon sides on the route. He reported that the jaded animals had been greatly benefited by the rich bunch grass, which abounded in this vicinity.

October 2.—To-day we remained in camp. I succeeded in repairing the cistern of the barometer by covering the crack with Husband's adhesive plaster, and then applying a coat of sealing wax dissolved in alcohol, to protect it from moisture. I re-filled the instrument, and had no further trouble with it on the survey. I also obtained good observations of the sun to-day. In the afternoon Dr. Newberry, who had been suffering for some time from fever and ague, was taken dangerously ill. We were all quite anxious on his account, as a bottle of arsenic had been broken in the medicine chest, and none of us, excepting himself, had any knowledge of the healing art.

October 3.—This morning Dr. Newberry was much better, and able to ride, with two men and myself, to Tysch creek. Lieutenant Williamson had authorized him to proceed to Vancouver by water, to examine certain coal mines in Washington Territory. I proposed to return on the following day to my party, after obtaining, if possible, a guide acquainted with the new pass near Mount Hood, of which the half-breed had spoken. On reaching Mr. Evelyn's house, we

heard some astounding news. A general Indian war had broken out; the Indian agent of Washington Territory and several other whites had been murdered; and Major Haller, with a large force of United States troops, had gone to meet the hostile tribes. All the settlers south of the Dalles had already fled from their ranchos, except Mr. Evelyn, and he had sunk his ferry boat, and was about to follow them the next morning. The situation of our little half-armed party, consisting of only seventeen men, now that Dr. Newberry was about to leave us, was anything but enviable. Encumbered with a large number of jaded animals and considerable baggage, we suddenly found ourselves among hostile and well-armed Indians, to whom our train would render us a tempting prey. A difficult and almost unknown range of mountains, now liable at any time to be blocked up with snow, separated us from the Willamette valley. Each of the three known passes across it seemed almost impracticable for us; that of the Columbia river, on account of the impossibility of obtaining a flat-boat to cross to the northern bank above the Cascades, while the war was raging in the immediate vicinity; and the wagon road, and the pack trail north of Mount Hood, on account of the entire absence of grass, which would render the loss of a large number of our almost broken down animals inevitable. I had a long conversation with the half-breed about the new pass. He said it was much more level than either of the others, and was well supplied with grass, but that the trail was so slight, and had so many forks leading to whortleberry patches, that a guide would be absolutely necessary. He positively refused to accompany me himself, being, as he said, afraid of the Indians. Feeling very much inclined to attempt the exploration of this pass, which, should the description prove true, would be very valuable for a wagon road, if not for a railroad, I inquired of Mr. Evelyn whether none of the little band of Indians, whose rancheria was near his house, could be trusted as a guide. He told me that, although they had not yet joined the hostile tribes, they had stolen several of his horses lately, and were growing rather insolent. Still he thought that their old chief, named Kok-kop, might be trusted a little while longer. As Major Haller had mentioned this Indian in high terms to me, I resolved to see him. To my surprise, he said that he knew nothing of this pass, and had never heard of it. This threw discredit upon the whole story, especially as half-breeds are noted for their strong imaginations. It was now evening. To guard against any sudden attack, I had the animals carefully tied to a strong fence; and dividing the night into three watches, took one myself and gave one to each of the men. It was very dark and cloudy, with occasionally a few drops of rain, and I could not but feel that our prospects were rather gloomy.

October 4.—This morning Kok-kop informed me that he had found a young man of his tribe who had been through this pass, and who would go as guide. As our chance of getting safely through the mountains with our animals, except by steamboat, which my instructions expressly forbade, was nearly desperate, I decided to trust him, and gratify my desire of exploring the pass. After the long and ceremonious council which Indians always require on great occasions, I succeeded in hiring the young man, on reasonable terms; or rather in bargaining with his chief for him, as he himself had no voice in the matter. The interview terminated by Kok-kop giving him strict orders to be obedient to me, and by my presenting Kok-kop with a red silk handkerchief.

Leaving Dr. Newberry to go to the Dalles with Mr. Evelyn, we returned to the rest of the party, with the new guide whose name was Sam An-ax-shat. He was about eighteen years old, and a very intelligent, neat, and, as the result proved, trustworthy Indian. For natural intelligence, he would compare very favorably with most white men. He spoke no English, but, fortunately,

I had acquired some knowledge of the Chinook language, and we were able to converse with considerable ease. After reaching camp, which we found undisturbed, we made every preparation to start to-morrow for the Willamette valley.

October 5.—This morning we followed a westerly course, near the southern slope of the Mutton mountains, through a slightly undulating region, covered with bunch grass and destitute of trees. After crossing a large trail leading from Tysch creek to Wam Chuck river, we passed over a slight spur from the Mutton mountains, and winding round the northern base of a prominent hill called Wah'-nit-ched, came upon a fine open prairie. Before long the trail suddenly turned towards the north round a steep hill, and we entered the forest, which extended almost without interruption to the Willamette valley. To-day it was open, without any fallen timber or bushes, and it consisted mostly of pine and larch. After travelling about twelve miles from camp, we reached, in the midst of the forest and at a short distance from the trail, a small spring called Wil-la-wit. There was good bunch grass near it among the trees. The guide said that we could not reach the next stopping place before dark, and, rather unwillingly, I concluded to encamp, taking every possible precaution against a surprise. We had found much silica on the road during the day, and here we obtained fine specimens of several varieties.

October 6.—There were indications of Indians around camp last night, and this morning, as we were about starting, one of them came to us and used insolent and threatening language. No attack or attempt to stampede our animals was made, however. Our course lay through a nearly level country, covered by an open pine forest offering no obstacles to travel. In about six miles we came to a little tributary of Wam Chuck river, called Wan-nas-see. It flowed in a small ravine, which the trail followed without obstruction for about a mile, to where a trail from Tysch creek entered it by a lateral cañon. At this spot the ravine became narrower, and fallen timber began to retard our progress. It grew worse as we advanced, until it was almost impossible to get the "little cart" over the huge logs. We toiled on, with much labor and difficulty, for about four miles further to a little open meadow, about a mile long and a quarter of a mile wide. It was called Yaugh-pas-ses, the Indian name for cranberries, which were plentiful in the vicinity. The Indians, when travelling from Tysch creek to their whortleberry patches near Mount Hood, choose this spot for the first camping place. They come, of course, by the trail which enters ours on Wan-nas-see creek, and which the guide said was a good one. I was very desirous to go further to-day, but Sam said that the fallen timber was very bad ahead, and the camping place a long distance off. We might possibly reach it about sundown, but I must certainly, as he expressed it in Chinook, "*mam'-uk mam'-a-loos ten'-as chik'-chik*"—that is, "kill the little cart." As most of the train was still struggling among the fallen timber in the rear, I concluded to encamp, and to adopt on the morrow a new order of march, better adapted to a country blocked up with logs and underbrush. I also decided, much against my will, to "kill the little cart." The men took the spokes for picket pins, and in this form, our old friend continued to accompany us to the end of the survey. We found many common varieties of silix on the route from Nee-nee to this point, but none afterwards. The grass of the meadow was coarse and not very nutritious, and water lay on the surface in many places. We encamped in the driest place we could find, and took all possible precautions against a night attack.

October 7.—To-day we had to struggle through a tangled forest of spruce, yew, fir, and pine, with many fallen logs crossing, and sometimes even piled up on the trail. On both sides of it,

they would have rendered an advance, without cutting a way with axes, impracticable. Driving about sixty loose animals through this forest was no easy task, as when the leaders were delayed by the logs, those behind would leave the trail on both sides, and crowd into places where it was impossible to advance and nearly so to retreat. Our usual order of march had been for the gentlemen of the party, with a man riding the bell horse, to form an advanced guard; while the packers, in charge of Mr. Coleman, brought up the rear of the train. The fallen timber now compelled me to separate the men among the animals, giving a certain number in charge to each man. This scattered our little party over a space of more than half a mile, and rendered a successful defence against a sudden attack almost hopeless.

Yagh-pas-ses meadow is drained by a small brook that discharges itself into a branch of Tysch creek, which we crossed a little more than a mile from camp. It was a clear rapid stream, about fifteen feet wide, flowing in a small ravine near the northern base of two prominent peaks, called Nu-ah-hum by the Indians. We followed along the side of this narrow valley about seven miles, to the source of the stream. It was a mountain lake called Wat-tum-pa, which was more than a mile long, bordered by a little meadow grass and surrounded with thick forests. Its banks were so miry that our animals could with difficulty drink. Here we were compelled to encamp; our mules had spent the day in jumping over or creeping under logs, and the men in struggling after them and repairing broken packs. We were all fully convinced that wandering amid "forests primeval" in poetry, and among the Cascade mountains, are two essentially different things.

We began to find among the trees a few mountain whortleberries, called Oo-lal-le by the Indians, who gather them in large quantities and dry them for winter food. There were two varieties, one large and black, growing on bushes about six feet high, and the other much smaller, of a blue color, and found on bushes of about half that height. Both were delicious when fresh. We also noticed that we had passed beyond the region of bunch grass, and that its place among the trees was supplied by a very coarse, deep green species, which none of the animals would taste.

October 8.—Last night a few of our animals strayed off into the forest, and we were delayed some hours in searching for them; by the great exertions of Mr. Coleman they were at length all found, and we started. The trail lay on a ridge, having a ravine parallel to it on each side. The fallen timber was not so troublesome as yesterday, but the forest, which was composed of huge trees of yew, fir and spruce, and some pine, was very dense. In about a mile we crossed a small stream with no grass near it. A mile further on we reached an open prairie, about one mile long and half a mile wide, covered with a coarse kind of grass; it was called by the Indians Lu-ah'-hum-lu-ah'-hum, and appeared to be sometimes occupied by the savages as a camping place. Doubtless there must be water near it, but we found none. There were several large trails here, but our guide, after hesitating a few moments, took a very small one leading west, through a thick forest of young trees and bushes. In about two miles we came to a beautiful mountain lake, called Ty-ty-pa. It had a narrow border of rich grass, separating it from the dense forest around; but the whole open space was only about half a mile long. This is the second camping place of the Indians when travelling from Tysch creek to the Willamette by this trail. It is also a favorite resort for gathering whortleberries, which we found growing in very great abundance. The ground had been dug over by bears in many places, and large numbers of ducks and a few wild geese were swimming in the lake. The forest concealed the surrounding country, but the Indian said that it was level for a long distance, both north and south, and filled with deer. He also said that the next water was very far off, and the

trail bad, and that we ought to encamp here. As it was now past noon, we did so. The grass had been eaten quite short by the Indian horses, but it was of a nutritious quality, and the animals fared pretty well. Mount Hood towered high above us, and his huge, snow-capped head, now appearing and now disappearing among drifting masses of clouds, gave a wild grandeur to the little camping place, which will be long remembered.

October 9.—To-day it rained furiously in the morning, and as I was very desirous to have a good view of the surrounding mountains when I crossed the dividing ledge, and as the animals greatly needed a day of rest, I decided to remain in camp. Towards evening it cleared off, and I measured by triangulation, as accurately as circumstances allowed, the distance to the summit of Mount Hood, the bearing of which, by the compass, was N. 4° E.; the resulting distance, about 14 miles, agrees very well with that given by our courses checked by latitude. In the evening, as usual, I obtained good astronomical observations.

October 10.—This morning the weather was clear. We started early, abandoning a horse that could travel no further. On leaving camp we ascended a steep hill about 400 feet high, and then gradually descended, for about a mile and a half, by a succession of pitches connected by narrow terraces. They conducted to a small brook, flowing north through a ravine destitute of grass. Continuing a southerly course for about two miles further, we found ourselves in a small dry prairie, where the trail suddenly seemed to disappear. Thus far to-day we had been very little troubled by fallen timber. Our guide dismounted, and, directed by signs too slight for our eyes, led us across the open spot to a place where the Indians had blazed the trees for a few rods into the forest, but where no trail on the ground was visible. We had before occasionally seen blazing, and sometimes twigs broken in the direction of the trail. The blazing generally consisted of a simple cut, laying bare the wood; but sometimes we found a rude image of a man marked in the bark. This always indicated that much fallen timber was to be expected. The object of the blazing, in the present instance, was simply to indicate a direction, for it soon ceased, and even Sam could see no trail. By carefully preserving the course it had pointed out, however, he led us about a mile up a gentle slope, covered with much fallen timber, to the brink of an enormous precipice, which seemed vertical. There was a trail near the edge, which conducted us up a gradual ascent to the foot of a very steep mountain, composed of basalt and compact metamorphic slate, whose summit was bare of trees. After climbing it with much labor, and the loss of a mule that rolled down the precipitous side, a magnificent panorama burst upon our view. At an elevation of 5,000 feet above the sea, we stood upon the summit of the pass.* For days we had been struggling blindly through dense forests, but now the surrounding country lay spread out before us for more than a hundred miles. The five grand snow peaks, Mount St. Helens, Mount Ranier, Mount Adams, Mount Hood, and Mount Jefferson, rose majestically above a rolling sea of dark, fir-covered ridges, some of which the approaching winter had already begun to mark with white. A yawning ravine, into which we had gradually and unconsciously descended this morning, came from the north, near Mount Hood, and winding to the south round the mountain on which we stood was lost in the dim distance. Another, heading near us, wound out of sight towards the west. On every side, as far as the eye could reach, terrific convulsions of nature had recorded their fury, and not even a thread of blue smoke from the camp fire of a wandering savage, disturbed the solitude of the scene.

Near this mountain we noticed an extraordinary local variation of the magnetic needle, which numerous bearings to well known peaks enabled me to measure with considerable

This is the summit by my trail. It is 500 feet higher than that of the proposed wagon road.

accuracy. At places about two miles from the mountain, both before reaching and after leaving it, the variation, as usual in this region, was about 18° east. At the top of the great precipice encountered about a mile before reaching the mountain, it was only 11° east, while on the summit it was 16° west. The needle was thus actually disturbed 34° by some abnormal cause. It, however, settled readily. The mountain was principally composed of slate and basalt, like those around it, and we could see no indication of iron or other local cause of disturbance in the vicinity.

During the remainder of the day's march, the trail followed a knife-like ridge between two great cañons east and west of us, to avoid the fallen timber in them, and it was very mountainous in its character. After a steep descent we toiled up another peak, two miles distant from the first and very similar to it. From the summit we could look many miles down the great westerly ravine, and distinctly see the blue hills of the Willamette valley beyond its mouth. This peak was separated from the next one of the ridge by a cañon connecting the two great ravines. This we crossed with difficulty, and continued to follow the narrow ridge, toiling up and down several more steep peaks rising from it, until the sun was only a few minutes high. Some of our exhausted animals were far behind, and the Indian said that we were still a long way from the "Stone House," where he had expected to encamp. He knew, however, a spring not far off, where we could get water, but no grass. We reached it on the steep eastern side of the ridge just as the sun set. Its bed was dry. We were all feverish from fatigue and thirst, and it was a bitter disappointment; still, to advance was impossible, and our animals were unpacked and tied to the trees as they gradually came in. Two had broken down entirely, and been abandoned on the way. In the meantime the Indian had disappeared. When he returned he quietly remarked that he had discovered water. We rushed to it, and found a little spring, which flowed almost drop by drop from under a rock in the thick bushes. There was enough for the men, but none for most of the suffering animals, and their cries from hunger and thirst were incessant through the night.

October 11.—This morning we took a westerly course, which led us over the ridge that we had been following, into a third great ravine heading near us and winding out of sight to the northwest. The descent was about seven hundred feet, and very abrupt. In the ravine we found a fine stream of water and a small lake, bordered by some good grass, which, however, had been eaten so short by Indian horses that our animals could get none. This place Sam called the "Stone House." The origin of its name I could not discover, but probably there is a cave in the vicinity. It is a great Indian whortleberry camp, and we found the bushes still loaded with berries. The lake is doubtless the source of a branch of Sandy river. Disappointed in finding grass for the animals, we toiled up a steep precipice of compact slate, 1,000 feet in height, to the summit of the western side of the ravine, and obtained an extended view of the surrounding country. On every side nothing could be seen but fir-clad ridges and frightful cañons; most of our animals were on the point of giving out from fatigue and hunger; and, to crown our misfortunes, Sam quietly informed me that he had only travelled between the "Stone House" and Willamette valley once, and that was when he was a child. He had a vague recollection of many mountains and a great scarcity of grass on the way. Under these happy auspices we pushed desperately on towards the west. After following a narrow ridge thinly covered with trees, until we had travelled a little more than six miles from camp, we fortunately found a small opening, in which the ground was wet from numerous springs and thinly dotted with grass. We had hardly encamped, when a rain storm that had been threat-

ning all the morning, suddenly burst upon us, causing great anxiety lest it should change into snow. Sam and I explored the vicinity on foot, and I was fortunate enough to obtain a good bearing to Mount Hood through the clouds. It was N. 40° E. We were on a narrow ridge, with an immense cañon on each side of us, and the supply of grass was very limited. The number of whortleberries was so great that we could strip them from the bushes by handfuls.

October 12.—All last night and to-day, a cold and steady rain poured down, chilling our animals and rendering the trail slippery and dangerous. Although I greatly feared snow, I decided to remain in camp and recruit the animals, as many must have given out had we proceeded. To eke out their scanty supply of grass, I issued a small quantity of hard bread, which most of them ate eagerly. We collected heaps of pine knots and logs in different parts of the opening, in order to pack the mules by fire-light on the following morning, and thus get a very early start. In the night it cleared off, and Mr. Anderson and I left our beds, and obtained good observations for latitude.

October 13.—We had reveillé at two o'clock this morning, and started as soon as it was light enough to see the trail. It followed a continuous ridge, varied by a succession of steep peaks, slippery from the rain. After slowly climbing over them for about three miles, we encountered one so steep that the ascent seemed impossible. We, however, carefully urged the animals along a narrow ledge, which wound up the face of the tremendous precipice, and at length gained the summit. The blue Willamette valley, marked by a line of fog rising from the river, lay below us, and the word "settlements," shouted down the line, inspired every one with new life. From this point we began a rapid descent to the level of the valley. At the foot of the mountain there was a small grassy swamp, around which the trail wound in nearly a semi-circle. Beyond it we crossed a rocky pedregal, and then followed another ridge less mountainous than the former one. It gradually disappeared, and left us among thick fallen timber. A very few clumps of bunch grass again began to appear among the trees. This trail had been used by the Indians of the Willamette valley to reach the whortleberry patches, and they had cut through many of the logs. Still vast numbers were left, and we were obliged, in several places, to clear a path with axes. We slowly worked our way on, in this manner, until night overtook us, and compelled us to encamp in the dense forest without either water or grass. During the night the cries of the half starved animals were very distressing. We also suffered much ourselves from thirst, which a diet of musty hard bread did not tend to allay.

October 14.—Yesterday, one of our best mules, with a valuable pack, was lost on the way, and I sent two men back this morning to search for him. The fallen timber diminished in quantity as we advanced, and the trail soon became excellent. Pressing rapidly forward we reached, about five miles from camp, a little log cabin on the edge of the forest, and, with a feeling of inexpressible satisfaction, found ourselves at last in the long wished for Willamette valley.

The owner of the cabin was in great fear and trouble. News had come by water from the Dalles, that all the Indians east of the mountains had banded together against the whites, and that Major Haller had been defeated, and his party of United States troops nearly cut off. The Governor of the Territory had called for volunteers, and great alarm was felt lest the Indians should cross the mountains, and attack the frontier settlements of the Willamette valley. This man was just starting to go to one of the large towns for protection. He expressed the greatest astonishment at our having succeeded in crossing the mountains, which had always been con-

sidered utterly impassable in this vicinity. He told me that the nearest place where I could obtain forage, was at the rancho of Mr. Hugh Currin, about four miles distant.

Continuing our course through a slightly undulating, well wooded country, we soon reached our destination, and encamping near a little stream by the house, succeeded in obtaining good pasturage, and an abundant supply of oats. Mr. Currin, to whom we are indebted for many acts of kindness, was the owner and first settler of Clackamas prairie, a fine little opening situated on the eastern bank of the Clackamas river. It was through the cañon of this stream, that we had first seen the Willamette valley. The non-appearance of the two men whom I had sent back for the mule rendered us all quite anxious to-night.

October 15.—To-day both the men came in, after an unsuccessful search. As this was an excellent place for our animals to recruit, I resolved to send Sam back for the mule, and to wait three days for his return. Many of the settlers were abandoning their ranchos, from fear of an Indian attack, and a general panic prevailed. We had the rare pleasure of reading in the newspapers an account of our own massacre in the mountains. At the expiration of the three days Sam returned with the mule. He had traced it, with an Indian's instinct, to where it had wandered from the trail, descended a deep ravine for water, knocked off the pack against a fallen tree, and then forced its way back over the logs to our camp near the "Stone House." His principal difficulty had been to replace the pack, but he had finally succeeded in lashing it to the animal's legs, neck, and tail, in such a manner that it was hard to conceive how the poor brute could have advanced a single step.

Having heard that Lieutenant Williamson's party was at Oregon City, we immediately prepared to rejoin it. I gave Sam his pay, with a few presents, and a supply of provisions for his journey back to his tribe. As he was very much afraid of some of the white settlers who had threatened to kill him, he started in the night. I have little doubt that we all owe our lives to the fidelity of this Indian.

October 19.—This morning we rode in a drenching rain to Oregon City, a distance of about sixteen miles. The country near the road was gently undulating in its character, and much of it heavily timbered. We saw on the way several good dwelling houses, cultivated fields, and other indications of civilization and prosperity. Oregon City is a thriving town on the eastern bank of the Willamette, built on a narrow plateau between the high river bluff and the water. We found Lieut. Williamson's party encamped near it, in charge of Lieut. Crook; and soon learned that our difficulties were not yet over. Lieut. Williamson had been compelled, by the lateness of the season, to return by water to San Francisco, in order to prepare for our contemplated exploration in the Sierra Nevada. He had left orders for me to take command of the party and make an examination and survey of the route to Fort Reading, by way of Fort Lane and Fort Jones. Major G. J. Rains, 4th infantry, notwithstanding the urgent remonstrance of Lieut. Williamson, had decided to detain our escort, now consisting of only eighteen dragoons, commanded by Lieut. Sheridan. Since Lieut. Williamson's departure, an Indian war had broken out in Rogue River valley, through which our route lay, and all communication between Fort Lane and the Umpqua valley was now cut off, except for strong and well armed parties. Ours consisted of Lieut. Crook and myself, Messrs. Fillebrown, Anderson, Young, Bartee, Coleman, and Vinton, with twenty packers, ten of whom were Mexicans. Several of our number were entirely unarmed, and others had only pistols. There were, I think, but five rifles in the whole command.

Two days were spent in making preparations for our survey. Finding myself thus unex-

pectedly deprived, at a time when its services were greatly needed, of an escort ordered by the War Department and detailed by General Wool, I first proceeded to Fort Vancouver, a distance of about nineteen miles, and addressed a written remonstrance to Major Rains, who was then at or near Fort Dalles. No reply, either to this or to that made by Lieutenant Williamson, was ever received. I have considered it incumbent upon me to communicate the whole correspondence; as the loss of the escort, besides occasioning great trouble, prevented some examinations very important to the determination of the practicability of the route for a railroad, and thus defeated, in part, the object for which a large appropriation of Congress had been set apart by the War Department. Before any of our escort left Vancouver, and before Major Rains' final orders in the case were issued, intelligence was received of the safe arrival of Major Haller's party at Fort Dalles.

Letter of Major G. J. Rains, Fourth Infantry, to Lieutenant R. S. Williamson, United States Topographical Engineers.

HEADQUARTERS, COLUMBIA RIVER AND PUGET SOUND DISTRICT,

Fort Vancouver, W. T., October 10, 1855.

SIR: From current rumors and the opinion of the Superintendent of Indian Affairs in Oregon, and from the report of Brevet Major Haller, in the field, with more than 100 men checked and surrounded by Indians, the lives of our citizens and even the safety of the military being in question, the services of every available man are required for the emergency. The body of nineteen dragoons, brought as your escort to this post, we are, therefore, obliged to detain for the time being—a kind of force most required.

I regret being thus compelled to break in upon any of your arrangements, and may be enabled, perhaps, in a few days to dispense with their services.

Very respectfully, your obedient servant,

G. J. RAINS,

Major, Fourth Infantry, Commanding District.

Second Lieutenant R. S. WILLIAMSON,
Topographical Engineers.

Letter of Lieut. R. S. Williamson, United States Topographical Engineers, to Major G. J. Rains, Fourth Infantry.

FORT VANCOUVER, W. T., October 10, 1855.

SIR: I have received your letter informing me of your intention "to detain for the time being" the body of eighteen dragoons which form the escort to my party. I conceive it my duty to lay before you the circumstances of the case, thinking that your instructions may be modified when the embarrassed position in which I shall be placed, without an escort, is made fully apparent.

The Secretary of War, in my instructions, says that the commanding officer of the department of the Pacific will detail 100 men, with not less than three commissioned officers, one of the latter to act as commissary and quartermaster to the expedition, to form the escort of the party; and, in obedience to these instructions, General Wool made the detail accordingly. Upon leaving the valley of the Des Chutes, I informed Lieutenant Gibson, commanding the escort, that I should have no further need of the services of his command, excepting Lieutenant

Sheridan and the dragoon detachment, thus reserving only such portion as I deemed indispensable. Lieutenant Crook would still be required as commissary and quartermaster. Accordingly, Lieutenant Gibson, with the remainder of the men, proceeded to Fort Jones and Fort Reading, from which places they were drawn. It now becomes necessary, in the prosecution of the duties assigned to me, to proceed to California, where I am instructed to make further surveys. The road leads through the Umpqua, Rogue river, and Siskiyou mountains, which are filled with hostile Indians. But three days ago I received intelligence of five men being murdered on the main road in the last mentioned mountains, and the newspapers for the last two months have been filled with accounts of Indian depredations in that vicinity. Without an escort, I shall incur the risk of losing my animals, and perhaps placing my men in a critical position.

The animals of the dragoons have been travelling in the field for nearly three months, subsisting upon grass, and the officer commanding the escort reports them unfit for service in any expedition where they will have to make other than short marches and cannot be provided with grain. Three animals have already completely given out, and had to be left at the head of the Willamette valley. These animals can go to Fort Lane, on a good road, where forage can be obtained every day, and there I expected to exchange them for fresh ones, with which to prosecute the other surveys; but they are incapable of being applied to the use for which you require them. The small number of men will be of great service to me, and they will not materially increase your forces in the field. Should I increase my party by hiring citizens, or should I lose my animals, in consequence of not having a proper escort, I shall incur expense which will fall upon an appropriation designed for a different object, and a deficiency in the amount to be devoted to the survey and office work may materially diminish the value of the results of the expedition, for which so large an amount has already been expended, and the importance of which, as estimated by the War Department, may be judged by the large appropriation (\$42,000) and the large number of men devoted to obtaining the information desired.

I have the honor, &c., &c.,

R. S. WILLIAMSON, *U. S. Top. Engs.*

Maj. G. J. RAINS, *4th infantry, U. S. Army,*
Commanding Columbia River and Puget Sound district.

Letter of Lieutenant Henry L. Abbot, United States Topographical Engineers, to Major G. J. Rains, Fourth Infantry, United States army.

VANCOUVER, WASHINGTON TERRITORY,

October 21, 1855.

SIR: I have the honor to report to you that I have arrived here with my detached surveying party, and have found that Lieutenant Williamson has returned to California by steamer, and left me in command of his whole party, with orders to proceed at once and survey the route from Vancouver, by Forts Lane and Jones, to Fort Reading. I deem it my duty before starting to explain to you the very embarrassed state in which the loss of my escort places me, thinking this may induce you to modify your previous instructions, and allow the eighteen dragoons, with Lieutenant Sheridan, to rejoin me.

As Lieut. Williamson, in his letter to you of the 10th inst., has explained very fully the

circumstances of the case, as far as they were then known to him, I shall only mention the additional reasons which, at present, render an escort so necessary.

My whole party, including Lieutenant Crook, myself, and the scientific corps, consists of 28 men, of which 10 are Mexican packers, and perfectly unreliable in case of an attack. Many of the party are unarmed. I think there are only five rifles in the whole command. I have about 120 animals, to herd which would fully occupy all the men in case of attack. I have with me all the notes of the whole survey, so that, if my party were cut off, the whole expedition would have been useless. According to the latest accounts, the Indians are very hostile, and are in the field in so large a force as to have cut off all communication with Jacksonville, and to have murdered 22 families. I enclose a copy of a despatch,* the original of which is in my possession, which shows the state of affairs on the road. As we have to make a second survey in the Sierra Nevada before winter, I am forced to advance at once with my small unprotected party, although it is the very general opinion that we may not reach Jacksonville without an escort. The time which would be required for me to see you in person would create so great a delay as to probably prevent the second survey in the Sierra Nevada, particularly as my animals are in so jaded a condition that I shall necessarily move slowly. I shall, therefore, start to-day for Fort Reading, and if you should decide to modify your previous instructions and restore the escort, a man will be at Vancouver, ready to ride express to inform me of the fact. Please direct to me at Vancouver, and the man will bring me your letter.

I am sir, very respectfully, your obedient servant,

HENRY L. ABBOT,

Lieut. U. S. Topographical Engineers.

Major G. J. RAINS,

4th Infantry, U. S. A, commanding Columbia river and Puget sound District.

I next went to Portland, and had an interview with Gov. George L. Curry, of Oregon Territory, to whom I feel under great obligations. He issued a general order, directing any volunteer officer to supply me with an escort, if practicable; and used his influence to aid me in every possible way. I feel that the success of the expedition is, in a great measure, due to his kind assistance.

I then returned to our camp at Oregon City, and, after discharging two men at their own request, completed the preparations for our return to Fort Reading.

** Extract from an extra of the Oregon Statesman,*

"CORVALLIS, Sunday, October 14.

"At noon, to-day, Mr. S. B. Hadley arrived at this place, express messenger, bearing a petition to Governor Curry for five hundred volunteers to repel the hostilities of the Shasta and Rogue river Indians, who are represented to be in a state of war towards the whites. The petition is signed by about 150 of the citizens of Umpqua valley. Among the names we recognize a number of prominent settlers there. The petition represents that some twenty or thirty families have been murdered! and dwellings burned; and that an attack upon the Umpqua settlements is feared. The houses burned and families murdered, thus far, were between Grave creek and Rogue river.

All communication with Jacksonville was cut off, and we hear nothing from the citizens there. It is conjectured, however, that the town is fortified. The mail carrier was shot at and driven back. The families between Grave creek and the cañon have been brought into Umpqua, for safety. There is no communication beyond the cañon now.

"Mr. Hadley says that Judge Deady, who had been holding court in Jackson county, with Mr. Drew, deputy marshal, confirm the intelligence, and say that from the mountains they could see the burning dwellings south of them."

ROUTE FROM VANCOUVER TO FORT READING, WEST OF THE CASCADE MOUNTAINS.

October 22.—To-day we left Oregon City, travelled about eighteen miles over an excellent road, and encamped on Pudding river. The country was level or gently undulating, and much of it covered with timber. We found the ford of the Molalle river rather deep. A ferry-boat is required at this crossing during the season of high water. Numerous houses and fine farms were passed on the way; and the land appeared fertile and valuable.

October 23.—This morning we crossed Pudding river by a toll-bridge, and then travelled about twenty-four miles to Salem. Our course lay through a level country called French Prairie, the fertility and thickly settled character of which strongly contrasted with the barrenness and solitude of most of the Des Chutes plateau. At Salem I saw the surveyor general of the Territory, and Mr. H. Gordon, deputy surveyor. To both of these gentlemen I am indebted for much valuable information and personal kindness.

October 24.—This morning it rained. We passed over the Willamette river at Rice's ferry, where the stream is deep and wide and the current rapid. One of our mules was drowned in attempting to swim across. We found difficulty in keeping our proper course to-day, on account of numerous forks in the road. There is also a very annoying custom, in this part of the valley, of enclosing by fences portions of the road, with the land on each side; thus rendering large circuits unavoidable. Soon after leaving Salem, we passed through a small collection of houses named Cincinnati, and crossed a little stream called La Creole river. The country was level or slightly undulating for the whole of the day's march. We encamped on Lackimute creek, having travelled about seventeen miles.

October 25.—The route to-day, which was in some places well timbered with oak, cedar, fir, and spruce, lay over a narrow and nearly level plain, bordered by high hills. We passed through Corvallis, a little town, consisting principally of one street lined by several stores and dwelling houses. It is built on a small stream called Mary's river, which rises near a peak of the Coast Range, bearing the same name, and discharges itself into the Willamette. We travelled 32 miles, and encamped on Long Tom creek.

October 26.—To-day we continued our course through the same narrow, level prairie, for 24 miles, to Eugene City, a small village near the junction of the Coast and Middle forks of the Willamette. A short distance north of the town, a line of low rolling hills, the principal peak of which is called Spencer's Butte, crosses the valley, and connects the Cascade and Coast Ranges.

October 27.—Our road to-day followed up the Coast fork of the Willamette, and we encamped near its head-waters, after a day's march of about 25 miles. The valley had become narrow and we occasionally crossed low hills. The soil was very fertile, and much of it cultivated. We experienced no little difficulty, however, in obtaining forage for our animals, as the Indian war in Rogue River valley had caused it to be in great demand.

October 28.—To-day we crossed, by the Pass creek road, the Calapooya mountains, which separate the Willamette and Umpqua valleys. Pass creek rises in a little meadow, which is also the source of a tributary of the Coast fork of the Willamette, and flows through the Calapooya mountains to Elk creek, a branch of the Umpqua river. This pass had only been known for a short time, and the wagon road was not fully completed when my party travelled over the route. Nothing but a few short bridges and a little grading, however, was wanting to make it a good and level road through the mountains. Having reached the Umpqua valley, we crossed a small divide between Pass and Elk creeks, and travelled towards the south through a narrow prairie bordered by rolling hills. The soil was fertile, and the neatly painted houses,

surrounded by cultivated land, greatly resembled those of the eastern States. We encamped near the end of this prairie, after a day's march of about 19 miles.

October 29.—On starting this morning, we passed over a steep hill with a flat and nearly level summit, and then travelled to Winchester, distant about 19 miles from camp. Our course lay through an undulating and very fertile country, varied with an occasional growth of oak and pine. Winchester is a little town situated on the southern bank of the North Umpqua river, at this point, a rapid stream about 80 feet in width, flowing over a very rocky bed. We crossed it in a ferry-boat, and encamped in the village during a heavy fall of rain, which continued through the night.

October 30.—We learned, upon good authority, that the reports from Rogue river had not exaggerated the Indian disturbances there. None but strong parties could pass through the valley, and most of the houses north of the river were burned. A large force of regular and volunteer troops was already in the field, and two additional companies were about starting to reinforce them. The election of field officers was to take place immediately at Roseburg, and we remained in camp to-day to await the result, before applying for an escort to Fort Lane. I repaired a barometer.

October 31.—This morning the road lay through a nearly level and very fertile valley to Roseburg, where I saw Major Martin, the elected commanding officer of the volunteers. He informed me that the troops were now fighting with the Indians, near the Umpqua cañon; and that he intended to join them on the following morning, with two more companies at present in camp at Cañonville. He kindly proposed to escort my party through the cañon, and I accepted his offer.

We continued our course up the valley of the South Umpqua river, and encamped with the volunteers near the northern entrance of the Umpqua cañon, at Cañonville, which consists only of one house and a barn. The road followed the stream for the greater part of the way, and the valley, although narrow, was settled, and much of it apparently very fertile. The hills on each side were lightly timbered with oak and fir. Several specimens of a hard variety of talcose slate were found during the day. The distance travelled was about twenty-six miles. In the evening a despatch was received from the battle field, stating that the troops were greatly in want of food and powder, and urging on the reinforcements. In the night it rained.

November 1.—This morning we followed the volunteers through the cañon, a difficult pass through the Umpqua mountains. Two small creeks head near the divide, and flow, one towards the north to the south fork of the South Umpqua, and the other towards the south to Cow creek. The bottom of the gorge is exceedingly narrow, and the precipitous sides, covered with a thick growth of trees, rise at least 1,000 feet above the water. We found in the cañon a species of yew-tree which we did not notice elsewhere west of the Cascade mountains. The ascent from the camp to the divide was 1,450 feet, and we were compelled, after crossing the creek about thirty times, to travel part of the way in its bed. A few resolute men might hold this defile against an army; and it is wonderful that the Rogue river Indians, who are intelligent, brave, and well armed with rifles, have never, in their numerous wars, seized upon it, and thus prevented the approach of troops from the Umpqua valley. This pass is about eleven miles in length, and communication through it is sometimes interrupted by freshets. The road over which we travelled was constructed in 1853, by Brevet Major B. Alvord, United States army, and it is the best route known through the Umpqua mountains.

We had hardly left the cañon when we began to see traces of the Indian devastations.

Blackened and smoking ruins, surrounded by the carcasses of domestic animals, marked the places where, but a few days before, the settlers had lived. We passed a team on the road; the oxen lay shot in the yoke, and the dark blood stains upon the seat of the wagon told the fate of the driver. Even the stacks of hay and grain in the fields had been burned. After leaving the cañon, we followed the narrow but fertile valley of Cow creek for a few miles, and then crossing a steep divide between it and Wolf creek, encamped on the latter stream. Major Martin intended to proceed, in the morning, to join in the battle which was going on among the mountains, at a distance from the road variously estimated to be from five to twelve miles. As he could not spare us an escort, we determined to press forward as rapidly as possible towards Fort Lane, trusting that the Indians would be too busy to attack our party. In the evening, however, stragglers from the fight began to come in. They reported that the provisions were entirely exhausted, and the powder nearly gone; that the Indians were numerous and very strongly posted; that several white men had been killed and many wounded; and that it had been thought best to fall back, for the present, and wait for supplies. The regular troops were on their way to Grave creek, and the volunteers were coming to our camp as fast as they could transport their wounded. The Indians did not follow them, and they all arrived before morning. The forage on the route had been burned, and our animals suffered much from want of food to-night.

November 2.—This morning Major Martin, escorted by a volunteer company, went to Grave creek to see Captain A. J. Smith, 1st dragoons, commanding the United States troops in the valley. He offered us the benefit of his escort, and we accompanied him accordingly. This gentleman, together with Captain Mosher and other volunteer officers, assisted us in every way in their power; and without this accidental aid our party would have found it very difficult to cross the valley.

Wolf and Grave creeks are separated by high and steep hills, covered with thick timber and underbrush. On reaching Wolf creek we found Captain Smith in camp, near a house surrounded by a small stockade. His supply of forage had failed, and he was forced, on this account, to prepare to return to Fort Lane as soon as a few men, who had died of their wounds, could be buried. Lieut. Gibson, formerly in command of the escort of our party, was among the wounded. Being compelled by want of forage to press forward as fast as possible, I applied to Capt. Smith for an escort. He gave me one so promptly that in less than fifteen minutes we were again on our way.

Between Grave and Jump off Joe creeks the road passed over a steep and heavily timbered divide. The Indians had killed two men in charge of a pack train on this hill, and the half burned remains of their wagon and packs were still to be seen. Near this place Major Fitzgerald, 1st dragoons, had overtaken with a scouting party and killed several of the savages. At Jump off Joe creek, a man driving swine had been murdered, and a large number of his animals lay dead in the road. On leaving this creek, we passed through an undulating and fertile country, sometimes open and sometimes thinly covered with a growth of oak, sugar maple, and a little pine and hemlock. After travelling until nearly sun down, we encamped at a building which had been preserved from the general ruin by the heroism of a woman named Harris. After her husband had been murdered and her daughter wounded, she had made a desperate and successful defence by shooting at the savages from between the crevices of the log house. The traces of her bullets upon the trees, which had shielded the Indians, and the marks of the tragedy within the dwelling, were plainly visible. Soon after dark a small party under the command of Lieut. Allston, 1st cavalry, arrived with the wounded and encamped. Captain Smith, with a few men, passed us on his way to Fort Lane. The length of our day's march was about fourteen miles.

November 3.—To-day we travelled about twenty-five miles to Fort Lane, crossing Rogue river at Evans' ferry. His house, and others south of the river, were now protected by a few soldiers. The disturbance had been confined to the northern side of the valley; but a few murders had been committed on the Siskiyou mountains, and the settlers were in great alarm. The road was gently undulating until we arrived at the ferry; but from that point it followed the level bank of the river nearly the whole distance to Fort Lane. The land appeared to be rich and valuable. The hills were thinly covered with oak, pine, and other kinds of trees. A short time before reaching the fort we passed a salt spring, at which the animals drank eagerly.

November 4.—To-day we remained in camp to recruit the animals, which had suffered very much from fatigue and hunger during the last few days. We were treated with every possible kindness and attention by the officers stationed at the post.

Fort Lane, at present a cavalry station, is pleasantly situated on the side of a low hill, near the junction of Stewart creek with Rogue river. The barracks and officers' quarters are built of logs plastered with clay. Much of the surrounding country is fertile and settled, but destructive Indian outbreaks are not unfrequent. On the opposite bank of Stewart creek there are some peculiar basaltic hills, with flat tops and precipitous sides, somewhat resembling those of the Des Chutes valley. The principal one, which is about five hundred feet high, is called Table Rock. Good observations were obtained at the fort, by which the altitude above the sea was found to be 1,202 feet, and the latitude $42^{\circ} 25' 56''$.

November 5.—This morning we continued our journey without an escort, as no Indian outrages of importance had been recently perpetrated on the route. We found many houses deserted, however, and great alarm prevailing among the settlers. After travelling about 26 miles up the valley of Stewart creek, we encamped at the house of Mr. Smith, near the foot of the Siskiyou mountains. The road was level, and the general appearance of the country was similar to that near the source of the Willamette river. The rolling hills that shut in the valley, were sometimes bare and sometimes thinly covered with trees. We passed, on the way, a hot spring, the temperature of which was about 100° Fahr. A continual escape of gas through the water gave it the appearance of boiling.

November 6.—This morning we crossed the Siskiyou mountains. At first the ascent was gradual; but the road soon began to wind up a steep slope, portions of which were rendered very slippery by clay and rain, until, at length, the summit, elevated 2,385 feet above camp, was attained. Here the mountain was densely timbered, but near the base there were comparatively few trees. The descent, for a short distance, was very abrupt; but it soon became gentle, and broken by a few hills. A pile of stones by the roadside marked the boundary between Oregon and California. When we passed this spot it was raining; but in the valley below, clouds of dust gave evidence of a long continued drought. The rainy season begins earlier in Oregon than in California; and it happened in several places that the first rain of the season occurred on the night of our arrival. Nature seems to have preceded legislation in making the Siskiyou mountains a boundary; for, after passing them, the appearance of the country immediately undergoes a change. Rounded and nearly bare hills, not unlike those of the Sacramento valley, near Benicia, began to appear; and a few scattered sage bushes reminded us of the plateau east of the Cascade Range. The general altitude above the sea, also, had increased between one and two thousand feet since leaving Rogue river. We crossed Klamath river at Dewitt's ferry, and encamped on its southern bank, after a day's march of about twenty-four miles.

November 7.—To-day we travelled about seventeen miles to Yreka, through a rolling prairie country. Most of the hills were covered with bunch grass, and entirely devoid of trees. We passed several houses near the road, and a saw mill on Shasta river, a small but deep stream crossed by a bridge. Yreka is beautifully situated in a little basin surrounded by high hills. Near it, Shasta Butte, the largest and grandest peak of the Cascade Range, rises abruptly from the valley, and, with its double summit, towers far into the region of eternal snow. This little city, which already contains several brick stores and dwelling houses, is a great depot of the northern mines, and gold digging is actually carried on in its streets. It is, however, divided from the settled portion of the Sacramento valley by such precipitous mountain chains that all its supplies are transported by pack trains; and until very recently a wagon road to Shasta has been considered impracticable. Two routes have lately been found, however, which, it is thought, will prove to be feasible.

November 8.—This morning we followed the course of a little tributary of Shasta river, through a rather stony, gold-bearing plain, to Little Scott's mountains, the divide between Shasta and Scott's valleys. The ascent and descent were very abrupt for a wagon road. After crossing the ridge, we soon struck a small branch of Scott's river, and passed down its valley; which, although not more than a mile in width, has a rich and fertile soil. We encamped at Fort Jones, distant about sixteen miles from Yreka. The fort is finely situated in an open valley surrounded by high and wooded mountains; the buildings are made of logs. The soil abounds in silica, but gold has not been discovered in the immediate vicinity in sufficient quantities to pay for working. The altitude of the post above the sea, determined by careful observations, is 2,887 feet. The latitude is $41^{\circ} 35' 42''$.4.

November 9.—To-day we remained in camp to recruit the animals, and to transact business with Lieut. Crook, the quartermaster and commissary of the expedition, who had been detached by Captain H. M. Judah, 4th infantry, commanding the post. This officer, who passed us on his way to Fort Lane, ordered Lieut. Crook to remain at Fort Jones, on account of the exigencies of the public service. I greatly regretted this order; for it obliged me to discharge the duties of quartermaster and commissary, both for my topographical party and for Lieut. Crook's train, which accompanied me to Fort Reading. This circumstance prevented me from leaving the command, and examining, with a detached party, the Sacramento river route; which, it is thought, might have been shown to be practicable for a railroad. The want of an escort, and the great uncertainty of obtaining forage, rendered it impossible to travel over this route with the whole train of nearly broken down animals; and the design of surveying it was necessarily abandoned.

November 10.—Last night it snowed. We remained in camp again to-day to finish the business with Lieut. Crook. John Mellen, one of our best men, was discharged at his own request.

November 11.—This morning we travelled about twenty-three miles up Scott's valley, and encamped at the foot of the high mountain chain which separates it from Trinity valley. Scott's valley is a very beautiful and fertile opening, lying among forest-clad ridges about two thousand feet in height. It varies from one to eight or ten miles in width, and is nearly destitute of timber, except on the banks of the stream. The soil is rich, and gold is found in some localities.

It rained a little in the valley, and snowed upon the mountains during the day.

November 12.—To-day Scott's mountain, the highest summit upon our return route, was crossed by a pack trail. We toiled up a steep and rocky ascent covered with trees, until an

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elevation of 2,141 feet above camp was gained. The snow was about four inches deep upon the top. In the winter it sometimes renders the trail impassable. A sudden descent conducted to the head-waters of a branch of Trinity river, which flows, in a deep and narrow ravine, between heavily timbered ridges. We were compelled to cross and re-cross this stream eleven times at bad fords, which became more and more rocky as they grew deeper. At length we encamped near a public house, after a hard day's march of twenty-four miles. This very bad trail, is, at present, the most travelled route between Yreka and the settled part of the Sacramento valley.

November 13.—To-day we continued our course down the narrow valley, crossing the stream five times more at very rocky fords. It received several small tributaries, which increased its size to nearly a hundred feet in width and about three feet in depth. The current was rapid. At the point where the river first bends abruptly toward the west, the trail leaves it and crosses Trinity mountains, the divide between it and Clear creek. A spur from the main ridge, lying between two immense ravines, extends about six miles towards Trinity river. The trail winds up the steep end of this spur, until an elevation of nearly 2,000 feet above the water is gained, and then follows along the top to the main ridge, through a forest of pine and oak. The descent of 2,543 feet to Clear creek is exceedingly abrupt. Although much labor has been expended upon the trail, this mountain is a very great obstacle to travel. We encamped at the first house we reached in the valley, after a hard march of about twenty-four miles.

November 14.—This morning we followed a pack trail about five miles down the narrow ravine of Clear creek to a mill, which is the terminus of the wagon road from Shasta. A few miles further on, we reached French gulch, a celebrated place for gold washing. The valley of the creek was here about a quarter of a mile in width, and the water had been conducted through it in every direction, by ditches. As many as a hundred men were engaged in digging and washing gold when we passed, and quite a little village had sprung up near the road. I was told that although the ground had been dug over several times, the amount of gold seemed to be undiminished.

We continued to follow the narrow valley of Clear creek, occasionally crossing low spurs from the sides to avoid bends, until we reached a few houses called Whiskey town. At this place the road left the stream, and passed through an open, rolling country to Shasta, one of the principal towns in northern California. Here we encamped, after travelling about twenty-one miles.

November 15.—To-day we arrived at Fort Reading, distant about seventeen miles from Shasta, and thus completed the field work of the survey. The road between the town and the Sacramento river, which we crossed at Johnson's ferry, led through an open and undulating region. From the ferry to the fort, it passed over a nearly level plateau, in some places well wooded, and in others entirely destitute of trees. We were received with great kindness and attention by the only officers at the post, Major F. O. Wyse and Lieutenant D. R. Ransom, both of the 3d artillery.

Lieutenant Williamson arrived from San Francisco a few days afterwards. He considered the season so far advanced as to render it inexpedient to attempt any exploration of the Sierra Nevada, near the sources of Carson river, before the ensuing spring, particularly as the most important examinations contemplated had been already anticipated by the State. Orders were soon received from the War Department, directing him to dispose of the outfit and return at once to Washington to prepare the report, maps, profiles, &c., of the survey already completed. The party reached the city in the latter part of January, 1856, and immediately entered upon office work.

CHAPTER VI.

COMPUTATION OF ALTITUDES FROM BAROMETRICAL OBSERVATIONS.

PRELIMINARY REMARKS.—INSTRUMENTS.—INSTRUMENTAL ERRORS.—INTERPOLATION, AND APPROXIMATE TEST OF ACCURACY IN OBSERVER.—CORRECTIONS PREPARATORY TO COMPUTATION: 1. FOR TEMPERATURE OF MERCURY; 2. FOR INSTRUMENTAL ERRORS; 3. FOR HOURLY OSCILLATION; 4. FOR ABNORMAL OSCILLATION.—METHODS OF COMPUTATION, WITH REMARKS: 1. ON THE READING OF THE BAROMETER AND THERMOMETER AT THE LOWER STATION; 2. ON THE READING OF THE THERMOMETER AT THE UPPER STATION.—EXAMPLE.—TEST OF THE COMPARATIVE ACCURACY OF THE DIFFERENT METHODS OF COMPUTATION, WITH TABLES SHOWING THE RESULTS OBTAINED.—HEIGHT OF FORT READING.—EXPLANATION OF TABLES OF BAROMETRIC OBSERVATIONS IN APPENDIX D, ETC.

PRELIMINARY REMARKS.

To insure accuracy in the old method of determining altitudes by the barometer, it is theoretically necessary that the observations at the upper and lower stations should be simultaneous. In obtaining the data for constructing the extended barometric profiles of the recent Pacific railroad surveys, many causes have rendered it impossible to comply, even approximately, with this condition. A new method of computation, based upon different principles, has therefore been required. Successive improvements have been introduced in computing the altitudes determined on the different surveys, until this object has been, in part at least, attained. Although several references to the subject have been made in the reports, the new system has never, to my knowledge, been published in a form sufficiently detailed for practical use. Partly to supply this deficiency, and partly to explain my reasons for believing that certain other slight changes in the old system are advisable, I have decided to describe in full the method used in reducing the field notes of our survey.

INSTRUMENTS.

On starting from Benicia we had four cistern barometers, Nos. 1060, 1061, 1068, and 1089, made to order, by James Green, of New York, on the same pattern as those used by the Medical Department of the army, but with scales graduated for greater altitudes, and with verniers reading to thousandths of an inch. We also had an aneroid barometer, but it proved to be so inferior an instrument that the few observations taken with it were rejected. We were likewise provided with four extra unfilled glass tubes.

The barometers proved to be admirably adapted to mountain work; but they had three defects, which gave us no little trouble. There were no portable tripods connected with them, which made it very inconvenient to take observations when there were no trees near the trail. Their verniers did not read higher than five hundredths of an inch, which rendered it necessary to look at both the scale and the vernier, and often to perform additions to determine the hundredths of the reading. This is very objectionable, as it renders mistakes almost inevitable, when the observations are taken during the hurry of the march. Lastly, the small pieces of wood to which the ivory points and the glass tubes were attached, were a little too large, and, in two cases, expanding from moisture while the glass cistern contracted from cold, actually cracked it,

and thus broke the barometer in a way very difficult to repair. It was successfully accomplished, however, by putting a little of Husband's adhesive plaster on both sides of the crack, and then covering it with sealing wax dissolved in alcohol, to protect it from the air.

INSTRUMENTAL ERRORS.

In order to eliminate the effect of capillary attraction, of minute bubbles of air which cannot be entirely excluded from a tube unprovided with Daniell's protective ring, and of other causes of instrumental error, the scales of all the barometers were so adjusted by the maker that the instruments agreed precisely with Smithsonian standard on leaving New York. On reaching Fort Reading, from a mean of over two hundred observations, taken with great care by the gentlemen of the party, Nos. 1060 and 1061 were found to agree exactly with each other, while both Nos. 1068 and 1089 differed slightly from them. It was assumed that the two former had remained unchanged; and corrections to make each of the others agree with them were deduced from the above mentioned observations, after the temperature of the mercury had been reduced to 32° Fahrenheit. Subsequently, whenever a barometer was broken and re-filled, a similar correction was deduced. The following table exhibits these corrections.

Barometer No. 1060.

Date.	Inches.
July 10 to September 18.....	.000
September 19 to September 29.....	+ .022
September 30 to October 15.....	+ .023
October 16 to October 29.....	+ .042
Subsequent to October 29.....	+ .191

Barometer No. 1061.

Date.	Inches.
July 10 to August 5.....	.000
Irreparably broken on August 5.....	

Barometer No. 1068.

Date.	Inches.
During whole survey.....	— .009

Barometer No. 1089.

Date.	Inches.
July 10 to August 5.....	+ .015
August 6 to September 4.....	+ .044
Subsequent to September 4.....	+ .035

INTERPOLATION, AND APPROXIMATE TEST OF ACCURACY IN THE OBSERVER.

Before proceeding to discuss the determination of altitudes, I shall explain the mechanical method used in examining and studying observations taken at a fixed station. It is to represent them, the temperature of the mercury having been reduced to 32° Fahr., by a curve, of which the abscissas denote the times of the observations, and the ordinates the corresponding height of the mercurial column. By this means any great error in observation can be readily detected by an abrupt change in the curve, and a very clear and comprehensive idea can be obtained of the relations of the different observations to each other. This also furnishes the best method of interpolating properly for intermediate readings.

CORRECTIONS PREPARATORY TO COMPUTATION.

1. *For temperature of mercury.*—In preparing observations for computation, the first step taken was to reduce the observed readings of the barometer to what they would have been had the temperature of the mercury been 32° Fahr. For this purpose the tables of Mr. A. Guyot, published by the Smithsonian Institute, were used.

2. *For instrumental errors.*—The correction for instrumental errors was then applied, and, when more than one barometer had been observed, a mean of the readings thus corrected was taken, to eliminate, as far as possible, errors of observation.

3. *For horary oscillation.*—The next step was to correct for the oscillations of the mercurial column, due to the ever varying weight of the atmosphere. Of these there are two kinds, the normal and abnormal. Although a monthly and a yearly normal oscillation, and also one depending on the amount of moisture in the atmosphere, are supposed to exist, still, we practically know but one, called the horary variation. This is a kind of daily atmospheric tide, caused principally by the heat of the sun, but greatly affected by the altitude and latitude of the place, and, doubtless, by other circumstances. It is far from constant, even at the same locality, as will be clearly shown by the result of our observations made at Fort Reading, in July and November.

Observations for the construction of a table of horary corrections should be taken hourly with very great care, and continued, if possible, for a long period of time; but this is not absolutely necessary. A good one may be constructed from observations taken even for a single day, when the mean temperature does not differ much from that of the season, and when there is little or no abnormal oscillation. The latter condition is generally fulfilled when the reading of the barometer, with the mercury reduced to 32° Fahr., is the same, or nearly the same, at the last observation, as it was at the same hour on the preceding day. Even when observations are taken for several days, the latter of these conditions must not be neglected; that is, the last observation, with the temperature of the mercury reduced to 32° Fahr., should always be very nearly the same as that taken at the corresponding hour immediately preceding the first observation used. This is manifestly necessary, as an abnormal change affects the horary curve. For instance, if the mercury should, beside the horary change, uniformly descend for one entire day and ascend for the next to the same height as before, the descending portion of the horary curve on the first day will be lengthened, and the ascending shortened, and *vice versa* on the second day. In a mean curve for the two days, these errors will balance each other.

To construct a table of horary corrections, the observations, after the temperature of the mercury has been reduced to 32° Fahr., should be represented by a curve, as already explained, and examined to detect any errors of observation and to reject any portion in which the effect

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7 A.M.
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10 A.M.
11 A.M.
12 A.M.
1 P.M.
2 P.M.
3 P.M.
4 P.M.
5 P.M.
6 P.M.
7 P.M.
8 P.M.
9 P.M.

Table 1

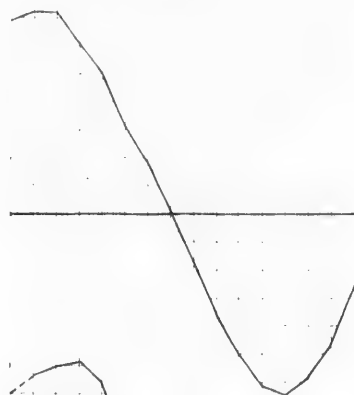


Table 3

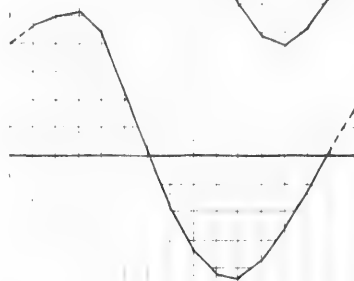
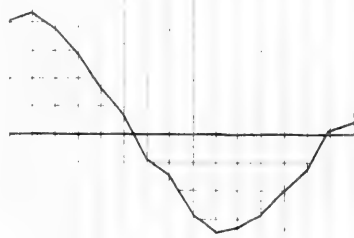


Table 2



Vertical Scale of inches

200
100
000
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000

Horizontal scale six hours to one inch
Vertical scale 20 inches to one inch

CURVES ILLUSTRATING THE TABLES OF HORARY OSCILLATION DEDUCED
FROM OBSERVATIONS TAKEN ON THE SURVEY.

of abnormal error is not balanced. Should one of the hourly observations be wanting on any day, a value, interpolated as correctly as possible by comparing the character of the curve between the hours preceding and following it on other days, should be substituted. A moment's consideration will show the necessity of this interpolation when there is any abnormal change from day to day. Still the great mistake of omitting it has often been made.

The observations having been prepared as explained above, a mean of all the observations at each hour is taken, and a curve plotted to represent these mean results. It should be a smooth curve, generally with two maximum and two minimum points in the twenty-four hours, the exact times of which vary somewhat. Should this curve not be smooth, some error of observation or calculation has been made. It now only remains to find the mean reading for this mean day, and to take the difference between it and each mean hourly reading, affecting the result with the positive sign when the hourly reading is the less, and with the negative when it is the greater. The correction from this table, applied with its sign to an observation taken at any hour, eliminates the error due to horary oscillation.

It may be well to remark, that it is a very good test of the value of a table of horary corrections to apply it to the curve representing observations taken for a few days at a depot camp. If a more sweeping line is produced, without a daily recurrence of any peculiar form, the table may be considered good for observations taken in the vicinity, where the mean temperature is about the same.

From the observations taken on our survey, the following tables of horary corrections were deduced. They proved to be well adapted to the peculiar characteristics of the different tracts of country through which we passed. The manner in which they were computed is fully shown in Appendix E.

Corrections for Horary Oscillation.

Hour.	Table 1.	Table 2.	Table 3.	Hour.	Table 1.	Table 2.	Table 3.
	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>		<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>
6 a. m.	— .069	— .040	— .045	2 p. m.	+ .017	+ .028	+ .033
7 a. m.	— .072	— .042	— .045	3 p. m.	+ .034	+ .034	+ .041
8 a. m.	— .072	— .037	— .049	4 p. m.	+ .048	+ .033	+ .043
9 a. m.	— .060	— .028	— .051	5 p. m.	+ .061	+ .029	+ .038
10 a. m.	— .050	— .016	— .043	6 p. m.	+ .064	+ .020	+ .026
11 a. m.	— .032	— .007	— .022	7 p. m.	+ .058	+ .013	+ .011
12 m.	— .018	+ .008	+ .001	8 p. m.	+ .047	+ .001	— .003
1 p. m.	— .002	+ .014	+ .020	9 p. m.	+ .027	— .004	.....

The curves on Plate XIII illustrate these tables. They represent the oscillation of the barometer as twenty times greater than it actually is, in order to clearly show its character.

Table No. 1 was deduced from six days' observations, taken in the latter part of July, at Fort Reading, at an elevation between five and six hundred feet above the level of the sea, and a mean temperature of 83° Fahr. The condition above stated was very well satisfied, and the table was applied to the observations taken in the Sacramento valley, where the mean temperature was very high.

Table No. 2 was deduced from five days' observations, taken in the latter part of August, near

the head of Des Chutes valley, Oregon Territory, at an elevation of about four thousand feet above the level of the sea, and a mean temperature of 50° Fahr. We were again fortunate in having little abnormal error, and the table was admirably adapted to the observations taken on the elevated plateau east of the Cascade range.

Table No. 3 was deduced from three days' observations at Fort Reading, taken about the middle of November, with a mean temperature of about 50° Fahr. Here a barometric storm rendered it necessary to reject four days' careful observations, to avoid the effect of abnormal error. During the three days, however, there was very little atmospheric disturbance; and the table was useful for the observations taken on my route from Vancouver, where the temperature was uniformly low and the elevation generally inconsiderable.

It is very interesting to compare these tables, especially the two for Fort Reading. As the Des Chutes curve was obtained from observations at a place differing widely from the others in altitude, mean temperature, and latitude, it is impossible to decide what part of its peculiarities is due to each of these causes of variation. The Fort Reading curves, however, are deduced from observations taken at the same spot, with a change of mean temperature only; and it is fair to suppose that the differences between them are due principally to this cause. These differences are, that the November curve has a more rounded form and departs less from the horizontal line representing the mean of the day, and that its points of maximum and minimum are nearer together by about three hours. These results are precisely what we should expect, from the great difference of 33° Fahr. in mean temperature, assuming the heat of the sun to be the cause of the horary oscillation; and they show conclusively that the horary variation is by no means constant, even at the same locality, for all seasons of the year. For some hours, the difference between the corrections in these two tables would affect the computed height of a station more than forty feet. This clearly proves the great error, which has sometimes been committed, of applying a table of horary corrections to observations taken at places of very different mean temperatures, and far distant from the spot for which it was computed.

4. *For abnormal oscillation.*—The abnormal oscillations of the barometric column are principally caused by general movements in the atmosphere, which are shown by repeated and numerous observations to extend rapidly and progressively over very large tracts of country. In the first volume of the third edition of Professor J. F. Daniell's *Treatise on Meteorology*, will be found a very interesting article upon these oscillations. It is illustrated by diagrams, constructed as explained above, which represent numerous barometric observations taken under the direction of the Meteorological Society of the Palatinate. For Europe, at least, they conclusively prove this most important principle of rapid and wide extension. In the third volume of this series of reports upon Pacific Railroad Explorations, will be found diagrams, prepared by Captain A. W. Whipple, United States Topographical Engineers, to represent barometric observations taken at different military posts by the Medical Department of the United States army. They show that the same principle is true for our western country. Slight local storms do not appear to produce much effect upon the height of the barometric column. The observations taken on our survey agree perfectly with these well known facts. One of our barometers, No. 1068, was left at Fort Reading during our field work, with Dr. J. F. Hammond, United States army, who kindly volunteered to have observations taken daily every third hour, from 6 a. m. to 9 p. m. I obtained a corresponding set of observations taken at San Diego, distant over six hundred miles, and one month's observations at Benicia, distant about two hundred miles from Fort Reading. Both sets were taken under the direction of medical officers of the

army stationed at these posts. They agreed very well in all important abnormal changes with Dr. Hammond's Fort Reading observations, and with those made at permanent camps on our route; the only difference being that the oscillations at San Diego were not so great as those at Fort Reading and Benicia. Hence, as we were never more than four hundred and fifty miles in a direct line from Fort Reading, it is fair to suppose that the abnormal oscillation over the whole region traversed during our survey, was practically the same as that measured by the stationary barometer at the fort.

The method taken to form a table of corrections for abnormal oscillations was this: all the observations taken at Fort Reading, San Diego, and Benicia, during the time that we were in the field, were reduced to what they would have been, had the temperature of the mercury been 32° Fahr. They were then corrected for the horary variation; those at Fort Reading by the tables deduced from our own observations; those at Benicia by one constructed by Lieutenant W. P. Trowbridge, Corps of Engineers, from a set of observations taken there by the Medical Department of the army; and those at San Diego by one kindly furnished me by Lieutenant J. G. Parke, United States Topographical Engineers, constructed from observations taken on his recent survey in that vicinity. The observations thus corrected were plotted, forming curves which represented the abnormal oscillations alone at the different places, and which, as already stated, were found to exhibit a remarkable correspondence. As both San Diego and Benicia were south, and the country surveyed by us north, of Fort Reading, I considered the curve constructed from observations taken there preferable to a mean of the three. I, however, used the other two to detect errors of observation, and sometimes, when the surveying party was at a considerable distance from Fort Reading, to determine the approximate velocity of a storm. Observations were taken at 6 and 9 p. m. and 6 a. m. at our camps, and, when we remained stationary, at many other hours during the day. These observations, corrected as above stated, also furnished an excellent check, by showing the direction of the abnormal curve where we were. It was found to agree remarkably with that at the permanent stations. I then made a laborious examination of the Fort Reading curve, carefully correcting it by the above mentioned checks. Three times, where the observations had been interrupted for a few days, the blank was filled by reference to the other curves. The resulting curve represented the abnormal oscillations affecting the observations on our route, and to form a table of corrections, it only remained to find its mean reading, and to take the difference between this and each of its three-hourly readings, affecting the result with the positive sign when the mean was the greater, and with the negative when it was the less. The values for intermediate hours were found by interpolation. The correction from this table, applied with its sign to any observation taken at the corresponding day and hour on the survey, eliminated the error arising from abnormal oscillation, by reducing it to the mean reading for the period for which the table was constructed. The importance of this correction may be seen from the fact that several times it affected the computed height of a station between two and three hundred feet, and, as it sometimes increased and sometimes diminished it, relative errors, amounting to between five and six hundred feet, would have resulted had it been neglected.

METHOD OF COMPUTATION.

After undergoing the four corrections above mentioned, the observations were ready for computation. The tables of Professor Elias Loomis were used for this purpose, the calculation being somewhat shortened by the method of preparing the observations. These tables are

exceedingly convenient, and, by not introducing logarithms, greatly diminish the liability to mistakes. The values assumed for a few of the quantities in the formula require notice.

1. *Reading of barometer and thermometer at lower station.*—The mean reading of the barometer at the level of mean tide at Suisun bay, near Benicia, was uniformly assumed for the reading at the lower station. Its value was determined by computation from very numerous observations taken by the Medical Department of the army, at the United States hospital, near the water's edge. It may be well to state that the altitude of the hospital above the level of mean tide, given as 64 feet in the returns sent to the Surgeon General's office, is erroneous, and that the more accurate altitude of 81.5 feet was found, by careful measurement in 1854 by Lieutenant W. T. Welcker, Ordnance Corps, United States army, at the request of Lieutenant Williamson. This altitude was used in computing the barometric reading at the level of mean tide from that at the hospital. It is 30.057 inches, the temperature of the mercury being 32° Fahrenheit, and of the air 64° Fahrenheit. It was considered better to refer all the observations to this fixed base, partly because, by computing from camp to camp or station to station, all errors would be propagated through the whole succeeding work, and partly because the great principle of this method of computation being to reduce the observed to the mean reading, it would seem better to take for the lower station a mean reading very well determined than one deduced from a few observations, and depending for its accuracy upon the correctness of the horary and abnormal tables. This reasoning was verified by the test of the Cañada de las observaciones, which will be fully explained in a subsequent part of this chapter.

2. *Reading of thermometer at upper station.*—It only remains to notice the air temperature at the upper station. As our method of computation differs in this from that of any of the Pacific railroad surveys yet published, I shall fully state the reasons which decided me to adopt the change. It had already been found that if, in this new method of computation, the observed air temperature was used, bad results were obtained, the very high temperatures giving too great altitudes, and the very low not great enough. To correct this source of error, Mr. L. Blodget constructed an empirical table of corrections, by comparing the results of a spirit level and a barometric survey of some passes in the Sierra Nevada, made by Lieutenant Williamson in 1853. Although the results obtained by using this table are doubtless more accurate than those given by the observed air temperature without this correction, still I cannot feel satisfied either with it or with the reasoning advanced to support it, based upon the difference between the "surface temperature" and that of the main body of the air. I think the source of the difficulty lies deeper, and that it may be anticipated from the very principle upon which the new method of computation is based. To understand this fully, it is necessary to refer to the formula used in computing altitudes from barometric observations, the temperature of the mercury at both stations being the same. It contains, beside terms depending upon the geographical positions of the stations, two compound independent variables, each of which consists of two mutually dependent variables. These are the height of the mercurial column and the corresponding air temperature at each station; and it must be carefully borne in mind that they are not four independent variables. The theory of the old method of computation was that, by taking simultaneous observations at both stations, all causes of error would affect them equally, and that by substituting these observed values for the variables, the formula would give a correct difference of altitude between the stations. This is slightly erroneous, for, as the ratio of the barometric readings enters into the formula, any error in them, even although it should affect both equally, would vitiate the result. A greater objection to the method is, that

all causes of error do not affect the observations at both stations equally, particularly when distant from each other. This has rendered it necessary, in preparing our extended profiles, to adopt a new method founded upon a different principle. This is, to substitute for the variables in the formula their mean values for the whole time occupied by the survey, which is supposed to be long enough to insure great accuracy in absolute altitudes. At any rate, relative errors are thus eliminated. These mean values are found for the lower station by long continued observations; for the upper station, the mean barometric reading is obtained by applying to the observed reading the horary and abnormal corrections, which reduce it to the mean for the desired period. The error of using with this value the observed air temperature is now apparent. It is virtually making the formula indeterminate, as, if the tables are correct, we shall have precisely the same values for all the other variables for every additional observation taken, and perhaps a different air temperature for each of them. But this algebraic result is as it should be, for the height of the mercurial column and the air temperature are, as above stated, mutually dependent variables requiring corresponding values. Hence, the theory of this method of computation, supposing the tables to be correct, plainly indicates that the mean air temperature for the time employed in the survey should be used in the formula. There is, however, a slight error in the abnormal table which modifies this result in practice. The horary table undoubtedly corrects the mercurial column for the effect produced by the changes in the heat of the sun during the day; but, although the abnormal curve is slightly affected by the difference in mean temperature from day to day, we cannot suppose that this change, depending so much upon local causes, extends uniformly over a large tract of country. Hence the abnormal table does not correct for it satisfactorily. This, together with the fact that we travelled over regions having widely different mean temperatures, which could not be determined from our few observations, led me to use, in all cases, the mean daily air temperature. It was found by taking a mean of the observations at 7 a. m., 12 m., and 10 p. m., or of those at 7 a. m., 2 p. m., and 9 p. m.; either method being well known to give a closely approximate value.

It is interesting to see how Mr. Blodget's empirical table suggests the use of a mean temperature in the formula, although he bases upon it a widely different theory, and one which, however applicable it may be in particular cases to the old method of computation, appears to me to entirely fail in showing the cause of the error resulting from using the observed temperature in the new method. This table reduces the temperature, when between 35° and 60° Fahr., to about 67° Fahr.; and when between 75° and 95° Fahr., to about 77° Fahr. Thus it not only approximates towards giving a mean temperature, but it even indicates a higher mean temperature when the weather is warm than when it is cold. As this table is entirely empirical, being deduced by comparing altitudes found by the barometer and the level, it is by no means necessary to consider that it sustains the "surface temperature" theory. It seems to me to confirm, as fully as could possibly be expected, considering the small number of observations from which it was deduced, the idea that the mean daily temperature should be used.

In computing altitudes, the practical importance of an error in the air temperature at the upper station greatly depends upon its height above the lower; an error of 1° Fahr. vitiating the result about one foot for each thousand feet of this height.

The following example is introduced to illustrate the method of computation above described :

EXAMPLE.

Data for determining the altitude of Camp 22, near upper end of upper cañon of Pit river.

Date.	Hour.	No. of barometer.	Reading of barometer.	Attached thermometer.	Detached thermometer.
1855.			<i>Inches.</i>	°	°
August 7	6 p. m.	1060	25.990	77.0	75.0
	6 p. m.	1089	25.957	77.0	75.0
	9 p. m.	1060	25.990	63.5	65.0
	9 p. m.	1089	25.953	63.5	65.0
August 8	6 a. m.	1060	26.025	48.0	47.0
	6 a. m.	1089	25.981	47.5	47.0

Corrections applied before computation.

	6 p. m., August 7.		9 p. m., August 7.		6 a. m., August 8.	
	Bar. 1060.	Bar. 1089.	Bar. 1060.	Bar. 1089.	Bar. 1060.	Bar. 1089.
	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>
Barometric reading	25.990	25.957	25.990	25.953	26.025	25.981
Correction to temperature of mercury	— .112	— .112	— .081	— .081	— .045	— .044
Correction for instrumental errors	.000	+ .044	.000	+ .044	.000	+ .044
Correction for horary oscillation	+ .020	+ .020	— .004	— .004	— .040	— .040
Correction for abnormal oscillation	+ .075	+ .075	+ .075	+ .075	+ .040	+ .040
Corrected readings	25.973	25.984	25.980	25.987	25.980	25.981

Mean of corrected readings, 25.981 inches.

Mean daily air temperature, about 67° Fahrenheit.

Computation by Loomis' tables.

$$H = 30.057 \\ t = 64^{\circ}$$

$$H' = 25.981 \\ t' = 67^{\circ}$$

$$\text{Part I gives for } \begin{cases} H = 30.057 & 27659.2 \\ H' = 25.981 & 23861.8 \end{cases}$$

$$\text{Approximate altitude } a = 3807.4 \\ \frac{a}{900} (t + t' - 64) = \frac{3807.4}{900} \times 67 = 283.4$$

$$\text{Second approximate altitude } A = 4090.8 \\ \text{Part III gives for } A = 4090.8 \text{ and } L = 41^{\circ} 50' = 1.8 \\ \text{Part IV gives for } A = 4090.8 = 11.1$$

$$\text{Altitude of station in feet} = 4103.7$$

TEST OF THE COMPARATIVE ACCURACY OF THE DIFFERENT METHODS OF COMPUTATION.

On a former survey in Southern California, Lieutenant Williamson surveyed two passes, the Tejon and the Cañada de las Uvas, with a spirit level and a barometer, for the purpose of testing the latter instrument. It was from these observations that Mr. Blodget deduced his empirical table referred to above. In accordance with Lieutenant Williamson's request, I took the original notes of the Cañada de las Uvas survey, which he considered rather more accurate than the other, and carefully tested by them these various methods of computing altitudes from barometric observations. Before referring to the results obtained, a slight description of the pass will be given.

The Cañada de las Uvas is a pass from the Tulare valley, in southern California, through the Sierra Nevada to the basin east of the range. A better place for experimenting with the barometer could not have been found, had this been the sole object of the survey. The stationary barometer was observed in a brush hut, at a depot camp situated near the head of the wide and open Tulare valley, at an elevation of 1,447 feet above the level of mean tide at Suisun bay, near Benicia, and distant 12.8 miles from the entrance of the pass. For about six miles this pass is a narrow gorge, bordered by ridges several hundred feet in height. It then becomes an open valley, from half to three-quarters of a mile in width. This character is preserved nearly to the first summit, a distance of about 5.5 miles. The road then crosses several branches of the Santa Clara, a river discharging into the Pacific, gains the summit of a second divide, and descends to the basin, which is elevated about 1,500 feet above the head of the Tulare valley. From the first summit to the basin, a distance of about 12 miles, the trail is bordered by low rolling hills; but the high ridges of the Sierra Nevada intervene between it and the Tulare valley.

By this description it will be seen that some of these test observations were taken in a narrow gorge, others in a wide valley, and others in an open undulating country, separated by a high range of mountains from the stationary barometer. The altitudes of the stations varied from 192 feet to 2,809 feet above Depot camp; and their distances, from 12.8 miles to 36.4 miles from the same place. A greater diversity in their positions could not have been desired.

The observations in the pass were taken with one of Green's cistern barometers, similar to those used on our survey. At the depot camp, another barometer of the same kind was used, together with two syphon barometers, which, although greatly inferior instruments, furnished a useful check upon errors of observation.

In making the test computations, I prepared the table of abnormal corrections from the observations at the depot camp. The table of horary corrections used was the one already mentioned, deduced from Lieutenant Parke's observations on his recent survey in the vicinity. The altitudes were first computed by the old method, with Lee's tables, using the carefully interpolated simultaneous readings at the depot camp for the barometric and thermometric readings at the lower station. To prevent the slight error arising from taking the ratio between two equally erroneous barometric readings, the corrections for horary and abnormal error were applied to the observations at both stations. The altitudes were then computed by the new method, first using the observed, and then the mean daily air temperatures. As the results were the heights of the stations above mean tide at Suisun bay, near Benicia, the altitude of the depot camp above that level was subtracted from each in order to institute a comparison between them and those determined by the spirit level and by the old method of computation; both of

which were referred to the level of the camp itself. The following tables exhibit the original data and the results deduced by each of the three different methods of computation. It will be seen that the altitudes of forty-eight stations were determined, the highest of which was 2,809.5 feet above, and the most distant 36.4 miles from, the depot camp. Assuming the altitudes found by the level to be correct, a little calculation will show that the old method, the new method with observed air temperature, and the new method with mean daily air temperature, give mean errors of 29.3, 28.9, and 9.2 feet; maximum errors of 142, 119.1, and 31.9 feet; and minimum errors of 1.8, 1.5, and 0.8 feet, respectively; and also, that about two-thirds of the altitudes determined by the last named method differ from the true heights less than nine feet.

COMPARISON OF THE DIFFERENT METHODS OF COMPUTING ALTITUDES FROM BAROMETRIC OBSERVATIONS, BASED UPON DATA OBTAINED IN THE SURVEY OF CAÑADA DE LAS UVAS, BY LIEUTENANT R. S. WILLIAMSON, UNITED STATES TOPOGRAPHICAL ENGINEERS, IN 1853.

Data.—Observations in Depot camp during survey of Cañada de las Uvas.

Date.	Hour.	Reading of barometer.	Att. therm.	Det. therm.	Date.	Hour.	Reading of barometer.	Att. therm.	Det. therm.
1853.	<i>h. m.</i>	<i>Inches.</i>	°	°	1853.	<i>h. m.</i>	<i>Inches.</i>	°	°
Sept. 28-----	6.00 a. m.	28.660	58.5	59.0	Oct. 2-----	5.30 p. m.	28.730	76.0	76.5
	9.00 a. m.	28.690	71.5	71.0		8.40 p. m.	28.752	77.0	77.0
	12.00 m.	28.666	79.0	79.5	Oct. 3-----	6.00 a. m.	28.755	62.5	63.0
	3.00 p. m.	28.623	84.0	83.0		9.00 a. m.	28.813	85.0	84.0
	5.35 p. m.	28.595	72.0	72.0		12.00 m.	28.782	95.0	95.5
	8.05 p. m.	28.610	66.0	68.0		3.30 p. m.	28.732	96.0	95.5
Sept. 30-----	6.00 a. m.	28.609	59.5	60.0		5.30 p. m.	28.710	86.0	85.0
	9.00 a. m.	28.680	80.5	80.0		7.30 p. m.	28.720	75.0	74.5
	12.00 m.	28.674	95.0	94.0	Sept. 29---	5.30 p. m.	28.560	77.5	77.0
	3.00 p. m.	28.650	94.0	94.0	Sept. 30---	6.00 a. m.	28.609	59.5	60.0
	5.30 p. m.	28.615	83.0	82.5	Oct. 1-----	6.00 a. m.	28.688	65.0	66.0
	8.10 p. m.	28.656	80.0	80.0	Oct. 4-----	5.30 p. m.	28.680	80.0	80.5
Oct. 1-----	6.00 a. m.	28.688	65.0	66.0	Oct. 5-----	6.00 a. m.	28.724	73.0	72.5
	9.00 a. m.	28.759	85.0	84.0	Oct. 2-----	6.00 a. m.	28.728	63.0	65.0
	12.00 m.	28.758	94.5	93.5		5.30 p. m.	28.730	74.0	76.5
	3.00 p. m.	28.715	96.0	95.0	Oct. 3-----	6.00 a. m.	28.755	62.5	63.0
	5.30 p. m.	28.690	83.0	83.0		9.00 a. m.	28.813	85.0	84.5
	8.00 p. m.	28.710	80.0	80.0		12.00 m.	28.782	95.5	95.0
Oct. 3-----	6.00 a. m.	28.728	65.0	63.0		3.30 p. m.	28.732	96.0	95.5
	9.00 a. m.	28.792	81.5	81.0		5.30 p. m.	28.710	86.0	85.0
	12.00 m.	28.758	93.0	92.0	Oct. 4-----	6.00 a. m.	28.751	73.0	73.0
	3.00 p. m.	28.760	94.0	93.5					

Data.—Observations in Cañada de las Uvas.

Date.	Station.	Hour.	Reading of barometer.	Attached thermometer.	Detached thermometer.	Altitude by spi- rit level above depot camp.	Distance from depot camp.
1853.		<i>h. m.</i>	<i>Inches.</i>	<i>°</i>	<i>°</i>	<i>Fed.</i>	<i>Fed.</i>
September 28-----	37 & 58	5.00 p. m.	28,425	86.0	85.0	193.4	67,740
	56	4.15 p. m.	28,240	87.0	84.0	384.3	70,879
	49	3.15 p. m.	27,900	79.0	79.0	720.4	75,971
	40	2.15 p. m.	27,718	77.5	77.0	917.4	79,237
	34	1.20 p. m.	27,600	81.5	81.0	1,055.8	81,474
	27	0.30 p. m.	27,520	85.0	81.0	1,158.6	83,561
	22	12.00 m.	27,420	75.5	75.5	1,260.8	85,312
	18	11.00 a. m.	27,305	78.0	77.5	1,387.0	87,719
	14	10.00 a. m.	27,240	71.5	71.5	1,466.6	89,394
	7	9.00 a. m.	27,080	66.0	65.5	1,628.0	91,996
September 30----	1	7.40 a. m.	26,922	72.0	70.0	1,774.4	95,369
	3	8.00 a. m.	26,898	74.0	70.0	1,809.7	97,732
	6	8.20 a. m.	26,861	75.0	73.0	1,874.0	99,873
	9	8.45 a. m.	26,810	77.0	74.0	1,931.1	102,424
	10	9.00 a. m.	26,790	81.0	75.0	1,967.7	104,674
	12	10.00 a. m.	26,744	83.0	79.0	2,045.0	108,557
	15	11.05 a. m.	26,640	82.0	81.0	2,160.0	112,167
	18	1.25 p. m.	26,364	85.0	83.0	2,372.5	121,382
	22	2.30 p. m.	26,152	85.0	84.0	2,618.6	125,860
	27	3.15 p. m.	25,960	82.0	82.0	2,809.5	128,834
October 1-----	31	10.30 a. m.	26,137	84.0	84.0	2,758.0	132,021
	33	11.40 a. m.	26,428	83.0	82.0	2,435.2	135,885
	38	1.10 p. m.	26,557	84.0	84.0	2,280.2	140,390
	40	3.00 p. m.	26,684	86.0	86.0	2,131.4	146,095
	45	4.30 p. m.	26,726	86.0	78.0	2,068.4	153,300
October 2-----	47	10.15 a. m.	26,710	86.5	84.0	2,172.0	156,200
	51	11.00 a. m.	26,838	86.0	85.0	2,002.7	158,704
	53	12.00 m.	26,930	90.0	89.0	1,909.7	161,175
	55	0.30 p. m.	26,910	93.0	90.0	1,914.4	163,885
	58	1.30 p. m.	26,950	90.0	90.0	1,874.7	167,988
	61	2.30 p. m.	26,882	91.0	89.0	1,922.3	175,360
	64	4.00 p. m.	26,930	91.5	87.0	1,869.3	179,932
October 3-----	66	8.30 a. m.	27,070	88.0	80.0	1,817.7	182,796
	68	9.00 a. m.	27,128	86.5	86.5	1,750.4	186,053
	74	10.45 a. m.	27,196	90.0	89.0	1,678.5	192,315
September 29-----	Camp.	6.00 p. m.	26,835	67.0	67.0	1,764.0	95,369
30-----	Camp.	6.00 a. m.	26,860	56.0	58.0	1,764.0	95,369
October 1-----	Camp.	6.00 a. m.	27,000	67.0	65.5	1,764.0	95,369
October 4-----	Camp.	6.00 p. m.	26,987	70.0	70.0	1,764.0	95,369
October 5-----	Camp.	6.00 a. m.	26,973	49.0	51.0	1,764.0	95,369
October 2-----	Camp.	6.00 a. m.	26,965	44.0	45.0	1,772.4	192,315
	Camp.	6.00 p. m.	27,018	75.0	76.0	1,772.4	192,315
October 3-----	Camp.	6.00 a. m.	26,990	47.5	48.0	1,772.4	192,315
	Camp.	11.30 a. m.	27,090	88.0	87.5	1,772.4	192,315

Data.—Observations in Cañada de las Uvas—Continued.

Date.	Station.	Hour.	Reading of barometer.	Attached thermometer.	Detached thermometer.	Altitude by spirit level above depot camp.	Distance from depot camp.
1853.		<i>h. m.</i>	<i>Inches.</i>	<i>°</i>	<i>°</i>	<i>Feet.</i>	<i>Feet.</i>
October 3----	Camp.	12.00 m.	27,087	88.0	88.0	1,772.4	192,315
	Camp.	3.00 p. m.	27,025	86.0	87.0	1,772.4	192,315
	Camp.	6.20 p. m.	26,965	82.0	82.0	1,772.4	192,315
October 4----	Camp.	6.00 a. m.	26,975	48.5	50.0	1,772.4	192,315

Results obtained by computation.

Date.	Station.	Hour.	Altitude by barometer above depot camp, computed by—			Differences between altitudes determined by barometer and spirit level.		
			Old method, using Lee's tables.	New method, using observed air temperatures.	New method, using mean daily air temperatures.	Old method, using Lee's tables.	New method, using observed air temperatures.	New method, using mean daily air temperatures.
1853.		<i>h. m.</i>	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>
Sept. 28	37 & 58	5.00 p. m.	219.9	213.7	195.2	— 26.5	— 20.3	— 1.8
	56	4.15 p. m.	403.2	461.8	383.1	— 18.9	— 17.5	+ 1.2
	49	3.15 p. m.	724.7	718.9	707.9	— 4.3	+ 1.5	+12.5
	40	2.15 p. m.	928.3	906.3	899.1	— 10.9	+ 11.4	+18.6
	34	1.20 p. m.	1078.6	1064.7	1046.8	— 22.8	— 8.9	+ 9.0
	27	0.30 p. m.	1189.0	1175.7	1157.2	— 30.4	— 17.1	+ 1.4
	22	12.00 m.	1271.0	1251.1	1248.4	— 10.2	+ 9.7	+12.4
	18	11.00 a. m.	1420.0	1407.8	1396.9	— 43.0	— 20.8	— 9.9
	14	10.00 a. m.	1473.0	1455.9	1463.3	— 6.4	+ 10.7	+ 3.3
	7	9.00 a. m.	1621.3	1596.7	1623.3	+ 6.7	+ 31.3	+ 4.7
Sept. 30	1	7.40 a. m.	1783.6	1755.5	1781.6	— 9.2	— 11.1	— 6.7
	3	8.00 a. m.	1818.0	1788.5	1815.1	— 8.3	+ 21.2	— 5.4
	6	8.20 a. m.	1867.8	1844.9	1861.8	+ 6.2	+ 29.1	+12.2
	9	8.45 a. m.	1935.4	1914.3	1928.1	— 4.3	+ 16.8	+ 3.0
	10	9.00 a. m.	1970.6	1946.7	1964.5	— 2.9	+ 21.0	+ 3.2
	12	10.00 a. m.	2032.9	2054.3	2049.5	+ 12.1	— 9.3	— 4.9
	15	11.05 a. m.	2138.3	2168.3	2157.4	+ 21.7	— 8.3	+ 2.6
	18	1.25 p. m.	2440.6	2389.7	2370.3	— 68.1	— 17.2	+ 2.2
	22	2.30 p. m.	2673.8	2541.4	2601.2	— 55.2	+ 77.8	+17.4
	27	3.15 p. m.	2870.1	2828.0	2810.6	— 60.6	— 18.5	— 1.1
Oct. 1	31	10.30 a. m.	2798.1	2767.1	2762.9	— 40.1	— 9.1	— 4.9
	33	11.40 a. m.	2463.4	2399.5	2403.3	— 28.2	+ 35.7	+31.9
	38	1.10 a. m.	2308.8	2277.0	2273.2	— 28.6	+ 3.2	+ 7.0
	40	3.00 p. m.	2144.5	2013.1	2102.5	— 13.1	+ 18.3	+28.9
	45	4.30 p. m.	2066.6	2049.8	2067.6	+ 1.8	+ 18.6	+ 0.8
Oct. 2	47	10.15 a. m.	2165.5	2187.0	2175.9	+ 6.5	— 15.0	— 3.9
	51	11.00 a. m.	2024.7	2012.4	1998.4	— 22.0	— 9.7	+ 4.3

Results obtained by computation—Continued.

Date.	Station.	Hour.	Altitude by barometer above depot camp, computed by—			Differences between altitudes determined by barometer and spirit level.		
			Old method, using Lee's tables.	New method, using observed air tem- peratures.	New method, using mean daily air temperatures.	Old method, using Lee's tables.	New method, using observed air tem- peratures.	New method, using mean daily air temperatures.
1853.		<i>h. m.</i>	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>
Oct. 2	53	12. 00 m.	1937. 9	1911. 7	1884. 7	— 28. 2	— 2. 0	+25. 0
	55	0. 30 p. m.	1971. 1	1934. 0	1903. 8	— 56. 7	— 20. 2	+10. 6
	58	1. 30 p. m.	1917. 7	1906. 5	1876. 1	— 43. 0	— 31. 8	— 1. 4
	61	2. 30 p. m.	1986. 2	1943. 3	1916. 0	— 63. 9	— 21. 0	+ 6. 3
Oct. 3	64	4. 00 p. m.	1921. 5	1895. 1	1874. 8	— 51. 9	— 25. 5	— 5. 2
	66	8. 30 a. m.	1809. 8	1811. 8	1811. 8	+ 7. 9	+ 5. 9	+ 5. 9
	68	9. 00 a. m.	1772. 7	1765. 2	1744. 2	— 22. 3	— 14. 8	+ 6. 0
	74	10. 45 a. m.	1692. 1	1703. 9	1675. 3	+ 13. 6	— 25. 4	+ 3. 2
Sept. 29	Camp.	6. 00 p. m.	1752. 1	1716. 4	1752. 3	+ 11. 9	+ 47. 6	+11. 4
Sept. 30	Camp.	6. 00 a. m.	1746. 6	1727. 7	1793. 7	+ 17. 4	+ 36. 3	—29. 7
Oct. 1	Camp.	6. 00 a. m.	1716. 1	1690. 1	1757. 1	+ 47. 9	+ 73. 9	+ 6. 9
Oct. 4	Camp.	6. 00 p. m.	1719. 3	1700. 0	1738. 8	+ 44. 7	+ 64. 0	+25. 2
Oct. 5	Camp.	6. 00 a. m.	1691. 7	1649. 1	1749. 7	+ 72. 3	+114. 9	+14. 3
Oct. 2	Camp.	6. 00 a. m.	1630. 4	1653. 3	1771. 0	+142. 0	+119. 1	+ 1. 4
	Camp.	6. 00 p. m.	1768. 1	1755. 7	1768. 8	+ 4. 3	+ 16. 7	— 3. 6
Oct. 3	Camp.	6. 00 a. m.	1707. 7	1679. 4	1784. 5	+ 64. 7	+ 93. 0	—12. 1
	Camp.	11. 30 a. m.	1794. 0	1784. 7	1760. 2	— 21. 3	— 12. 3	+12. 2
	Camp.	12. 00 m.	1780. 2	1778. 2	1752. 4	— 7. 8	— 5. 8	+20. 2
	Camp.	3. 00 p. m.	1797. 0	1776. 2	1754. 4	— 24. 6	— 3. 8	+18. 0
Oct. 4	Camp.	6. 20 p. m.	1740. 2	1707. 8	1766. 6	+ 32. 2	+ 64. 6	+ 5. 8
	Camp.	6. 00 a. m.	1714. 6	1670. 7	1775. 3	+ 57. 8	+101. 7	— 2. 9

No trial was made of Mr. Blodget's empirical table, for, as it was deduced from these very observations, they would not give a fair idea of its value. As has been already mentioned, the method was tested of using successively each place of observation for the lower station, with the next above it for the corresponding upper; but, as might be expected, errors were found to be propagated, and to be very considerably greater than when the sea level was constantly used for the lower station.

The result of this investigation, confirming so fully the accuracy of the new method of computation, cannot but be satisfactory. When it is remembered that two nice adjustments are required in reading the barometer, it must be considered that a mean error of 9 feet, amounting to only about nine thousandths of an inch of the mercurial column, is a wonderfully close approximation, when the difference of the altitudes computed amounts to nearly 3,000 feet. That this method has slight causes of inaccuracy, even in theory, is not denied; but this result tends strongly to show that practically their effect is unimportant. It is not supposed that the mean error in the altitudes on our survey is so small as 9 feet; but that the profile is sufficiently correct for all the purposes of a preliminary reconnaissance, I have not the slightest doubt.

Whenever water-courses gave practical checks upon the relative altitudes of different stations, as was often the case, the profile bore the most careful study in a perfectly satisfactory manner, and confirmed, without exception, the use of the mean daily air temperature, instead of the observed, in the computation.

HEIGHT OF FORT READING; EXPLANATION OF TABLES OF BAROMETRIC OBSERVATIONS, ETC., IN
APPENDIX D.

The great number of observations taken at Fort Reading has enabled me to compute its altitude in two different ways; one of which is independent of the tables of horary and abnormal correction. We had very careful hourly observations taken from July 22 to July 26, and from November 17 to November 22, inclusive. It is well known that a mean of the observations at 7 a. m., 2 p. m., and 9 p. m., differs very little from the mean barometric reading for the whole twenty-four hours; and, as five of the days on which the above mentioned observations were taken were in the dry, and six in the rainy season, it is probable that a mean of their mean readings thus found may approximate to that of the year. It is 29.506 inches. The corresponding mean air temperature, found by taking a mean of the observations at 7 a. m., 12 m., and 10 p. m., for the eleven days, is $62^{\circ}.3$ Fah. The altitude given by these data is 518 feet.

By the second method, I applied the tables as in other cases, and found the corrected mean of all our observations at the fort, which were about 600 in number, and, with the corresponding mean air temperature, computed the altitude. It is 544 feet, differing only 26 feet from the other. I have adopted the first result on the profiles, as it is obtained from observations taken with very great care, while many of the others are less reliable.

The tables in Appendix D exhibit the original data for the construction of our profiles, and the altitudes deduced from the observations. It must be remembered that all the altitudes are referred to the level of mean tide at Benicia, as the barometric reading at the sea level north of that place is not known. The column headed "corrected barometric reading" gives the height of the mercurial column, after the corrections for reduction to 32° Fahr., for instrumental error, and for horary and abnormal oscillation, have been applied. The very slight difference between these corrected readings, when there are several taken at the same camp, confirms the accuracy of the horary and abnormal tables.

CHAPTER VII.

ROUTE FROM SHASTA VALLEY, EAST OF SHASTA BUTTE, TO FORT READING; EXPLORED BY LIEUT. R. S. WILLIAMSON, UNITED STATES TOPOGRAPHICAL ENGINEERS, IN 1851.

EXPLANATION.—PARTY.—YREKA IN 1851.—START.—VIEW OF TWO PASSES.—WRIGHT LAKE.—WATER HOLE.—PORCUPINE KILLED.—TURNED BACK.—PASS.—EXTENDED VIEW.—PUMICE-STONE.—DIFFICULT TRAVELLING.—NO WATER OR GRASS.—NATURAL BRIDGE.—PEDREGAL.—WATER IN FISSURE.—BRANCH OF FALL RIVER.—FALL RIVER.—FORD.—INDIANS.—PIT RIVER.—TULE RAFT.—EXPEDIENT.—PASS THROUGH WESTERN CHAIN OF SIERRA NEVADA.—BATTLE CREEK.—COW CREEK.—SETTLEMENTS.

As Lieut. Williamson proposed to add a short description of this expedition to his report, I have compiled the following sketch from his field notes.

The exploration was made in accordance with instructions from Major P. Kearney, 1st dragoons. Lieut. Williamson's party consisted of twenty civilians, one of whom was Mr. Freaner, subsequently killed by the Pit river Indians near the lake that now bears his name. The expedition started from Yreka, then a little town called Shasta Butte city, and composed of about forty houses made of canvas and wood. The population may be estimated from the fact that five hundred and ninety-nine votes were polled for alcalde when Lieut. Williamson was there. On July 3, a depot camp was made on Willow creek, about sixteen miles from the town, and the preparations for the exploration commenced. A prismatic compass, with a sextant and artificial horizon, were the only available instruments.

July 8.—To-day we started, and, after travelling about fifteen miles over a good route, encamped near Sheep Rock.

July 9.—After passing over a gentle divide northeast of Sheep Rock, the road skirted a plain evidently covered with water in the rainy season. We travelled about nine miles in a northeast direction, and then turned southward, over low hills. In about ten miles we struck a fine little stream in a prairie, and encamped. The grass was excellent; and wild onions were abundant in the vicinity.

July 10.—Ice, half an inch thick, formed last night. After travelling towards the east for about five miles, we came to a shelf of black rock, fifty feet high, from which we had a fine view. There seemed to be two breaks in the hills; one towards the southeast, near a prominent conical butte, and the other and lower one towards the northeast. Thinking our course to be intermediate between the two, I selected the latter. We soon reached a second shelf, higher than the other; and a short distance beyond crossed a small creek flowing through a prairie. Here we struck a trail, which we followed up a mountain southwest of the pass, until it disappeared. We continued our course to the summit. A large sheet of water, supposed to be Rhett lake, lay about twenty miles distant, in a northeast direction. A level, timbered valley, bordered by hills, extended to the shore. We continued our course, and in about seven miles encamped near a water hole. We killed a bear and porcupine on the route, and had already deer, antelopes, and mountain sheep in camp.

July 11.—Thinking that we were gaining too much distance towards the east, I turned back, and struck for the pass near the conical butte. After winding about in a dense mass of bushes and small trees, and gradually ascending a long slope, we found ourselves within about half a mile of the base of the peak. Turning towards the south we soon reached the summit of the pass. The conical butte rose on our left, and a higher round hill on our right. Leaving the train, Mr. Frenner and myself went to the top of the latter, and obtained an extended view in every direction, except the northeast. We saw Mount Pitt, Klamath lake, and Shasta valley; but Rhett lake was hidden by the pine trees on the conical butte. Southward, as far as the eye could reach, the country was densely timbered, and apparently tolerably level, but broken by occasional low ridges. Lassen's butte was distinctly visible. Toward the southeast we saw a strip of yellow, which appeared like a prairie with two or three small lakes in it. This was supposed to be Fall River valley, distant about forty miles. While waiting for us, the men found a little snow on the conical butte. We started to proceed in the direction of Fall River valley, but it was impossible to keep a straight course, on account of the many obstacles encountered. The country was covered with pumice-stone, and a few bare hills were merely heaps of this substance. During the afternoon we searched for water constantly, but in vain. We encamped after sunset, without either water or grass, having travelled about twelve miles from the pass.

July 12.—We started before sunrise, and followed a very winding course, on account of rocks and manzanita bushes. At one place we came to a fissure 40 feet in width and still more in depth, which it was necessary to cross. Fortunately we discovered a natural bridge, supported by a very perfect arch, which afforded us a safe passage. While struggling forward, one of the men in the rear of the train discovered water in a deep hole, and we at once encamped. Having watered the animals and prepared breakfast for ourselves, we again started, and forced our way, with great difficulty, over a rocky pedregal to the foot of a hill, where we found a better road. I went with Mr. Frenner to the summit, and saw the valley ten or twelve miles distant, and separated from us by a densely timbered region, broken by low ridges. We continued our course, and soon reached a little prairie covered with flowers and grass, where we encamped, and obtained water by digging.

July 13.—We started early this morning, and followed a winding course to avoid, and yet to keep near, the rocky pedregal on our left. In about six miles we struck a small branch of Fall river, flowing west of south. Crossing it, we soon found an Indian trail near its bank. In about three miles the stream made a bend towards the east. We followed it, and in about 3.5 miles reached Fall river, flowing southeast. After passing down its bank for about four miles, we encamped. The valley was open and covered with grass below camp, but above, timber concealed the view.

July 14.—This morning we followed down the river to its mouth, a distance of seven miles. About two miles below camp it was one hundred yards wide. We crossed it above the rapids, near its mouth, at what would have been a good ford had the banks been cut down a little. There was a large Indian rancheria near, and we were joined by several of its inmates, who professed themselves friendly. After giving them a few presents, we descended a steep bluff to Pit river, and passing over it on a tule raft encamped on the southern bank. My mercury had been lost in crossing the pedregal, but I obtained a good observation of the sun for latitude by using water instead.

This camp of Lieutenant Williamson was in nearly the same spot as our Camp 20. On July 15, he followed almost the same trail that we subsequently did, through Stoneman's ridge, and encamped on Canoe creek, between our Camps 18 and 19. The following extracts from his journal describe his route from this camp.

July 16.—We started early, and followed a westerly course. The road was good, although occasionally rocky. After travelling about ten miles, and ascending two high ledges, we found ourselves in a little prairie, in which there were two Indian rancherias. A small creek, rising among the hills, flowed through the prairie, and after spreading out into several branches probably sank. Turning our course towards the south, we travelled about five miles to the foot of a steep ascent. We gained the summit in about three hours, and encamped near the sources of Battle creek, with an abundant supply of excellent grass and water. Lassen's Butte was in plain sight towards the southeast.

July 17.—We started early this morning to follow a westerly course, and for several hours were winding about among hills, rocks, and thick bushes. The road, however, was occasionally good. At the expiration of this time we had reached the foot hills, which extend for a considerable distance into the Sacramento valley. Soon afterwards we struck the main branch of Cow creek, which we crossed without difficulty. We encamped upon its banks, about a mile from the crossing, after a hard day's march. The grass was excellent in the vicinity. We felt very sensibly a great change in temperature, due to the difference in elevation between the morning and evening camps.

July 18.—We travelled about sixteen miles down the creek to its junction with another branch, and then turned towards the south. In a short distance we struck Lyon's trail, which we followed to the Sacramento river. We crossed the stream, and encamped on Cotton-wood creek, about two miles from Major Reading's house.



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